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The Effectiveness of Surficial Erosion Control Products

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The Effectiveness of Surficial Erosion Control Products

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Abstract: The effectiveness of three erosion control blankets and four hydraulic mulches used for temporary control of surficial erosion were quantitatively evaluated using simulated rainfall on highway slopes. Runoff and soil loss were measured at two-minute intervals so the effectiveness could be evaluated with different rainfall amounts.

All of the erosion control products reduced total runoff and soil loss relative to the bare soil plots, but to varying degrees.

An examination of the stability of the erosion control mulches showed that all were relatively stable throughout the rainfall event.

The study has quantitatively ranked the effectiveness of several of the erosion control products used in highway construction. The utility of these products, in controlling both runoff and soil loss, has been documented to assist in the selection of appropriate protection for highway construction sites. The methodology is an appropriate way to quantitatively evaluate the effectiveness of new erosion control products that will come to the market in the future.

Comments: A further analysis of the data used in this report can be found in a paper by J.J. Armstrong, and G.J. Wall, published as MAT-91-05.

Key Words: Univeral Soil Loss Equation, USLE, soil loss ratio, VM factor, mulches, erosion control blanket, soil erosion.

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Executive Summary

The effectiveness of seven temporary products used in highway construction erosion control were quantitatively evaluated. The erosion control products included three blankets (Aeromat, Curlex, S75) and four mulches (Conwed, Ecofibre, Albion Hills hydromulch, Verdyol).

Each of the erosion control products was evaluated at highway construction locations on 2:1 slopes prepared to MTO specifications. The products were subjected to 30 minutes of simulated rainfall at an intensity of 2.67 mm min^{-1}. Runoff and soil loss were measured at two-minute intervals so the effectiveness of the erosion control products could be evaluated with different rainfall amounts.

All of the erosion control products reduced total runoff volumes relative to the bare soil control plots. The Curlex and Conwed products were most effective in reducing runoff; Verdyol, S75, and Ecofibre were moderately effective; and the Aeromat, and Albion Hills hydromulch were least effective. The effectiveness of the products in reducing runoff also varied with time. Conwed, Ecofibre and Verdyol reduced runoff volumes for the initial 15 minutes of the storm, but produced runoff volumes analogous to the bare soil control for the rest of the event. The Albion Hills hydromulch was similar to the control plot throughout the rainfall event. The Aeromat and S75 products reduced runoff for the initial 10 and 20 minutes, respectively, but for the rest of the event runoff volumes were analogous to the control plots. Curlex reduced runoff volumes throughout the entire rainfall event.

The erosion control products were all effective in reducing soil loss, relative to the bare control plots. The most effective products in controlling soil erosion were the Aeromat blanket and the Albion Hills hydromulch. The Conwed, Curlex and S75 were moderately effective, while the Ecofibre, Fibramulch and Verdyol products were least effective.

The stability of the erosion control mulches was evaluated by monitoring changes in suspended sediment during the rainfall event. Any abrupt changes in sediment concentration would be indicative of the initial failure of the erosion control product. Analysis of the data revealed that all of the erosion control mulch products remained relatively stable throughout the rainfall event.

The study has provided a quantitative data base for many of the erosion control products used in highway construction. The utility of these products, in controlling both runoff and soil loss, has been documented to assist in the selection of appropriate protection for highway construction sites. The methodology used is an appropriate way to evaluate, quantitatively, the effectiveness of new erosion control products that may come to the market in the future.

1/ Introduction

The fundamental principles for the control of water erosion relate to the reduction of rainfall energy at the soil surface, and the reduction of runoff through improved infiltration. Much applied research has been conducted to develop and test cropping, residue and water management erosion control strategies in rural landscapes. In urban settings and transportation/utility corridors, a wide variety of different natural and synthetic mulches, barriers, blankets and structures has been utilized for soil erosion control.

To facilitate the planning and design of erosion control strategies in rural environments, research has been conducted to quantify soil erosion reduction achieved by different remedial measures. A similar approach has been applied to erosion control on highway construction sites with the development of VM factors for use in a soil erosion prediction equation [6]. However, little quantitative assessment has been conducted on most of the mulches and barriers which are on the approved "Designated Sources for Materials" list of the Ministry of Transportation. The absence of this quantitative data hinders the planning development and implementation of cost-effective erosion control measures.

Historically, the effectiveness of soil erosion control mechanisms have been evaluated in two manners. Firstly, natural rainfall events were used to measure the level of soil erosion control achieved by different remedial measures. These studies were limited because they were difficult to replicate for a wide variety of rainfall intensities. Also, in order to obtain statistically reliable data, the studies had to be conducted for many years, at great expense. Secondly, rainfall simulators have been used to evaluate erosion control products in laboratory and field settings. The use of the rainfall simulator facilitated the evaluation of products over a wide range of intensities. However, its use in the laboratory was complicated by difficulties in achieving soil conditions analogous to field conditions. Similarly, the use of the rainfall simulator under field conditions was hampered by equipment that was not sufficiently portable to allow a large number of replicated observations under field conditions to be obtained at a justifiable cost.

Recently, researchers at the School of Engineering and Federal Land Resource Research Centre at the University of Guelph developed and calibrated a relatively portable rainfall simulator for use in field studies of soil erosion and sedimentation processes [5]. In subsequent papers, the same authors published data on the comparison of the simulated rainfall properties to the properties of natural rainfall [6,7]. The simulator can produce rainfall intensities ranging from 17.5 mm h^{-1} to in excess of 200 mm h^{-1} by employing several low-to medium-flow rate, full jet nozzles in a continuous-spray design.

This rainfall simulator has already been used extensively by researchers at the University of Guelph

This rainfall simulator has already been used extensively by researchers at the University of Guelph to study soil erosion and hydrological processes under field conditions. Wall *et al.* (1990) have used the simulator to study temporal variation of a range of physical and hydrological properties of soil, as well as to measure temporal variation in soil erodibility. The rainfall simulator has also been used to quantify the effect of erosion control remedial measures, such as residue levels and intercropping strategies, on soil and water losses [9].

In a recent study, Armstrong and Wall (1990) developed and tested an approach to evaluate erosion control products used in highway construction under field conditions using rainfall simulation technology. This current study has been developed to meet the following objectives:

a) to evaluate quantitatively the effectiveness of seven erosion control products,

b) to establish the range of rainfall energies over which erosion control products remain effective,

c) to provide a quantitative ranking of the erosion control products.

2/ Study Approach

The study approach employed was developed previously by Armstrong and Wall (1990). It uses simulated rainfall to evaluate the effectiveness of erosion control products installed to Ministry specifications on highway construction sites.

3/ Methods

3.1/ Study Sites

Several highway construction sites were visited to locate soil and slope conditions suitable for study. Suitable site conditions included relatively erodible soils, 2:1 slope gradients, and slopes graded and top dressed to MTO specifications. Two sites were found to test four erosion control mulches and one site was located to investigate three erosion control blankets. Erosion control products were installed to MTO specification by either MTO personnel or company representatives (Albion Hill Mulch).

3.2/ On-site Procedure

Runoff and erosion plots (1 m^2) were established adjacent to each other on the 2:1 slope where the erosion control products had been applied. The plots were established both on bare soils, and also on soils where the hydraulic mulches or erosion control blankets had been installed. Each plot consisted of a three-sided metal boundary with the open side in the downslope position. A metal lip and trough were installed at the open end to stabilize the soil at the lower boundary and collect runoff [1].

Simulated rainfall was applied to each plot at an intensity of 2.67 mm min^{-1} (160 mm h^{-1}) for a duration of 30 minutes [5]. Runoff volumes were recorded and sampled at 2-minute intervals for the duration of the experiment. Approximately 100 ml subsamples of runoff were obtained in duplicate for laboratory determination of sediment content.

Surface soil samples (0-20 cm) were collected from sites adjacent to runoff plots for laboratory soil characterization. Immediately prior to runoff experiments, surface soil samples (0-5 cm) were collected in duplicate to measure antecedent soil moisture.

3.3/ Laboratory Procedures

Soil samples were analyzed for particle size distribution, organic matter content, pH, and calcium carbonate content according to methods described by [3]. Soil moisture content was determined gravimetrically.

Sediment concentrations in runoff were determined, gravimetrically, in duplicate by filtering runoff through pre-weighed 0.45 µm filters under vacuum pressures.

The amount of protection afforded to the soil by a particular treatment is indicated by the Soil Loss Ratio (SLR) or VM factor. This factor is a ratio of the amount of soil loss under a particular treatment to the amount of soil loss on the same site under bare conditions. SLR/VM factors were calculated at various intervals during the rainfall simulations for the blanket and mulch treatments, after methods described by [10] and [2].

3.4/ Statistical Analyses

Comparisons of runoff, soil loss and sediment concentrations were made among the treatments. Analyses of Variance (ANOVA) were performed, utilizing the SAS procedures [4] to determine whether or not significant differences ($P = 0.05$) existed between the various treatments and replicates. Duncan's Multiple Range Test was used to identify the treatments which differed significantly.

4/ Results

The evaluation of the erosion control products was conducted at three separate locations. Hydraulic mulches (Conwed, Ecofibre, Verdyol) were studied on fill-slope material, adjacent to a recently constructed overpass at the future intersection of Highways #427 and #407, northwest of Toronto. The Albion Hills hydromulch was studied on cut-slope material in Albion Township, north of Highway #9 on the Townline. The erosion control blankets (Curlex, Aeromat, S75) were evaluated on cut-slope material in Waterloo on Highway #86 just north of Northfield Drive.

Soil characterization at the study locations is reported in Table 1. The erosion control mulches were studied at the Toronto and Albion Hills sites, where the soils ranged from clay loam to loam textures. Soil erodibility values (K) for the Toronto and Albion Hills sites were approximately 0.19 and 0.43, respectively. The severe erodibility potential for the Albion Hill site is attributed to the high (>60%) silt + very fine sand content and the low (<1%) organic matter content.

The erosion control blankets were studied on loam textured cut slope materials in Waterloo. The erosion potential for these sites was computed to be moderately severe (K = 0.33). These loam textured soils are less erodible than the loam textured soils at Albion Hills, due to higher organic matter content and lower silt, plus very fine sand content. At each study location, the control site exhibited the same general soil characteristics as the test sites. Recent rainfall resulted in each soil being at, or near, field capacity prior to rainfall simulation. Photographs of each of the study locations and erosion control products are shown in Appendix A.

Each study plot was subjected to simulated rainfall for 30 minutes, at an intensity of 2.67 mm min^{-1}. Figure 1 illustrates the total amount of rainfall that was delivered to the plots with time, the rainfall energy (EI) associated with different rainfall amounts, and the probable return period of given amounts of rain within specific time periods. For example, the rainfall amounts occurring after 4, 6, and 10 minutes of simulation are equivalent to 5, 10, and 25-year return period storms. Similarly, the rainfall amounts occurring after 5, 10, and 20 minutes of rainfall are equivalent to storm energy (EI) values of 103, 412, and 1645 MJ mm ha^{-1} h^{-1}, respectively. For southern Ontario, the average annual EI value of approximately 1300 MJ mm ha^{-1} h^{-1} is reached in just less than 20 minutes.

Table 1/ Soil characterization of the study locations

Toronto

Plot	Depth Texture	GR	VCS	CS	MS	FS	VFS	Total S	Si	C	pH	CaC03	Organic Matter	"K" Value
	cm	% by weight										%	%	
Control	0-20 Clay Loam	0	1.0	1.8	3.5	10.4	16.0	32.7	38.5	28.8	7.1	1.1	3.5	0.22
Conwed	0-20 Clay Loam	0	1.0	1.5	3.5	11.5	16.1	33.6	37.5	28.9	7.1	2.1	3.7	0.18
Ecofibre	0-20 Clay Loam	0	0.9	1.9	4.1	10.5	14.4	31.8	36.8	31.4	7.1	3.6	3.7	0.19
Verdyol	0-20 Clay Loam	0	2.5	3.6	5.3	10.8	13.8	36.0	35.0	29.0	7.2	5.4	3.2	0.19

Albion Hills

Plot	Depth Texture	GR	VCS	CS	MS	FS	VFS	Total S	Si	C	pH	CaC03	Organic Matter	"K" Value
	cm	% by weight										%	%	
Control	0-20 Clay Loam	2.9	1.3	1.1	2.0	9.4	15.2	29.0	47.6	23.4	7.4	30.9	0.2	0.40
Hydromulch	0-20 Clay Loam	2.8	2.2	1.6	2.4	13.1	24.1	43.4	42.3	14.2	7.3	27.4	0.5	0.46

Waterloo

Plot	Depth Texture	GR	VCS	CS	MS	FS	VFS	Total S	Si	C	pH	CaC03	Organic Matter	"K" Value
	cm	% by weight										%	%	
Control	0-20 Clay Loam	4.7	2.6	4.1	9.2	13.4	16.8	46.8	41.4	12.4	7.1	8.7	2.6	0.34
Curlex	0-20 Clay Loam	4.7	3.7	3.9	8.9	13.3	16.3	46.0	41.2	12.7	7.1	8.8	2.7	0.32
Aeromat	0-20 Clay Loam	5	2.1	3.8	8.1	12.7	17.6	44.3	43.1	12.7	7.1	7.1	2.7	0.34
S75	0-20 Clay Loam	4.3	2.1	4.5	10.5	14.4	16.7	48.2	40.0	11.8	7.2	10.2	2.3	0.33

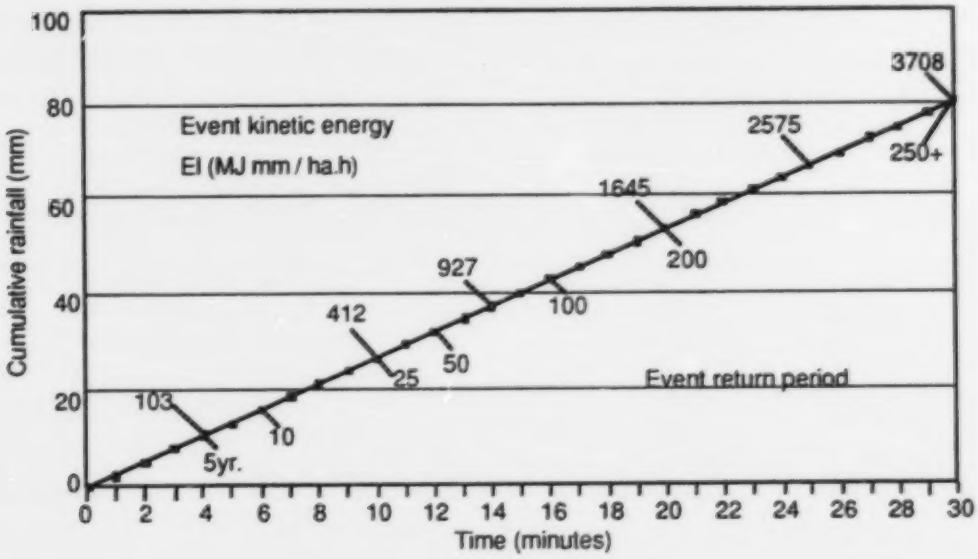


Figure 1/ Total rainfall, rainfall energy (EI), and return period probability associated with the duration of simulated rainfall

All soil and water runoff data collected have been included in the Appendices. Appendix B includes the data from each of the treatment replicates, while Appendix C includes the treatment means.

4.1/ Runoff

4.1.1/ Erosion Control Mulches

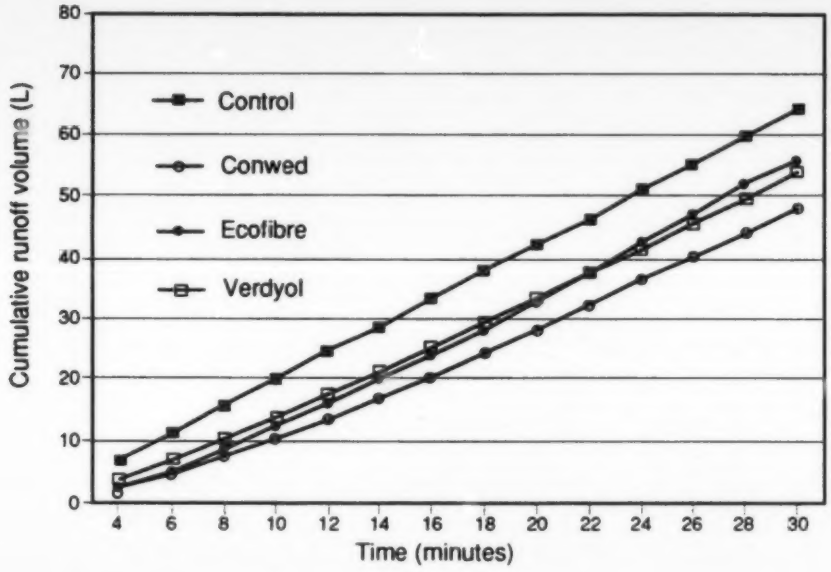
The cumulative runoff volumes from the erosion control mulch plots are shown in Figure 2. All the raw data are included in Appendix B. In each case, the total runoff from the erosion control mulch products is lower than that from the respective control plot. Runoff is reduced most by Conwed, while Ecofibre and Verdyol reduce runoff similarly. While similar in total runoff reduction, Ecofibre tends to be more effective in reducing runoff for the first half of the rainfall event, while Verdyol was slightly more effective for the latter half of the rainfall event. The Albion Hills hydromulch was the least effective in reducing runoff from the plots relative to the control plots. It should be noted that runoff from the control soils are not similar, reflecting differences in the inherent erodibility of the two soil materials studied.

The percent of runoff reduction achieved by the erosion control mulch products relative to the control plots, for each time interval, is shown in Table 2. While all the erosion control mulch products reduced total runoff volumes from the plots, it should be noted that after 10 to 20 minutes of rainfall, runoff from the Albion Hills hydromulch and Ecofibre became greater than those from the bare soil control plots. In each of these cases, the mulch product must be inhibiting infiltration into the soil relative to infiltration into the bare soil. Conwed and Verdyol reduce runoff volumes by approximately 10% over entire rainfall event. Actual runoff volumes, at two-minute time intervals, are shown in Appendices B and C.

Statistical analysis of the runoff data is reported in Table 3 for return period storms ranging from 5 to 250+ years. The following erosion control mulches (Conwed, Ecofibre, Verdyol) resulted in significantly ($P=0.05$) lower runoff losses relative to the control plots, however the Albion Hills hydromulch was not significantly different from the control plot.

4.1.2/ Erosion Control Blankets

The cumulative runoff volumes from the erosion control blanket plots are shown in Figure 3. All the raw data are included in Appendix B. Although all the erosion control blanket products reduce the total amount of runoff, the Curlex product is most effective, followed by the S75 and Aeromat materials. The percent of runoff reduced with the blanket products is shown in Table 2. The Curlex product reduces runoff relative to the control plot throughout the entire rainfall event. The S75 blanket reduces runoff relative to the control for about 18 minutes, while for the last 12 minutes of the event, runoff losses are



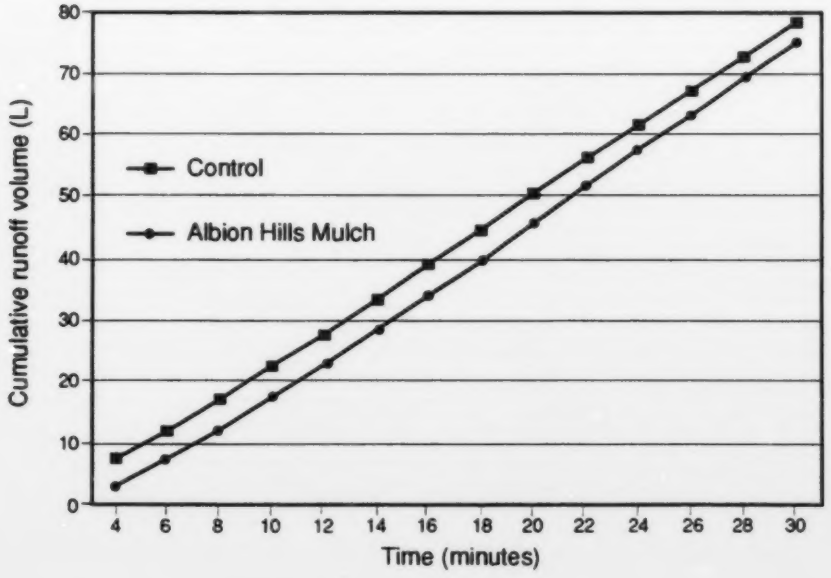


Figure 2/ Runoff from erosion control mulch plots

Table 2/ Percent reduction in runoff with erosion control products relative to the control plots

Sample Time (min)	Mulches				Blankets		
	Conwed	Ecofibre	Verdyol	Hydromulch	Curlex	Aeromat	S75
2	71.3	70.2	53.1	-	-	-	-
4	67.0	62.3	42.3	65.5	93.2	32.5	77.4
6	55.1	46.9	32.6	1.5	75.1	24.9	55.2
8	42.6	27.8	26.3	4.6	66.5	13.6	36.6
10	29.8	12.7	16.3	2.2	47.0	4.3	28.0
12	32.4	12.9	18.4	- 1.8	36.2	- 3.3	13.1
14	15.5	4.9	3.9	- 5.7	27.2	- 1.4	12.9
16	12.7	14.9	13.4	1.9	33.9	8.3	19.6
18	10.5	5.4	16.0	- 2.6	25. 3	- 1.0	7.7
20	35.2	- 16.4	- 1.0	- 4.0	18.7	- 7.7	0.7
22	38.0	- 8.4	1.6	- 0.6	15.5	- 8.3	2.8
24	42.9	- 0.3	15.5	- 5.9	12.6	- 11.2	- 3.4
26	37.0	- 20.4	- 2.7	- 5.3	12.9	- 9.6	0.4
28	44.3	- 5.6	11.2	- 5.9	12.6	- 9.1	3.7
30	37.7	- 10.8	10.5	- 8.6	10.0	- 5.7	0.0

Table 3/ Statistical analysis of runoff, sediment concentration, and soil loss data (ANOVA and Duncan's Multiple Range Tests)

Erosion Control Mulch Products

Return Period (Years)	Runoff				Soil loss				Sediment Concentration			
	Control	P3	P4	P5	Control	P3	P4	P5	Control	P3	P4	P5
5	A	C	BC	B	A	B	B	B	A	B	B	B
10	A	C	BC	B	A	B	B	B	A	B	B	B
25	A	C	BC	B	A	B	B	B	A	B	B	B
50	A	C	BC	B	A	B	B	B	A	B	B	B
100	A	C	BC	B	A	B	B	B	A	B	B	B
200	A	B	B	B	A	C	BC	B	A	B	B	B
250 +	A	B	A	AB	A	C	BC	B	A	B	B	B

	Control	P2	Control	P2	Control	P2
5	A	B	A	B	A	A
10	A	A	A	B	A	A
25	A	A	A	B	A	B
50	A	A	A	B	A	B
100	A	A	A	B	A	B
200	A	A	A	B	A	B
250 +	A	A	A	B	A	B

Erosion Control Blanket Products

Return Period (Years)	Runoff				Soil loss				Sediment Concentration			
	Control	Ae	Cu	S75	Control	Ae	Cu	S75	Control	Ae	Cu	S75
5	A	A	A	A	A	A	A	A	A	B	B	B
10	A	AB	B	B	A	B	B	B	A	B	B	B
25	A	AB	C	BC	A	B	B	B	A	B	B	B
50	A	A	B	AB	A	B	B	B	A	B	B	B
100	A	A	B	AB	A	B	B	B	A	B	B	B
200	A	A	B	AB	A	B	B	B	A	B	B	B
250 +	A	A	B	AB	A	B	B	B	A	C	BC	B

Treatments with the same letters do not differ significantly (p = 0.05)

Treatments: P2 (Albion Hills hydromulch), P3 (Conwed), P4 (Ecofibre) P5 (Verdyol), Ae (Aeromat), Cu (Curlex), S75

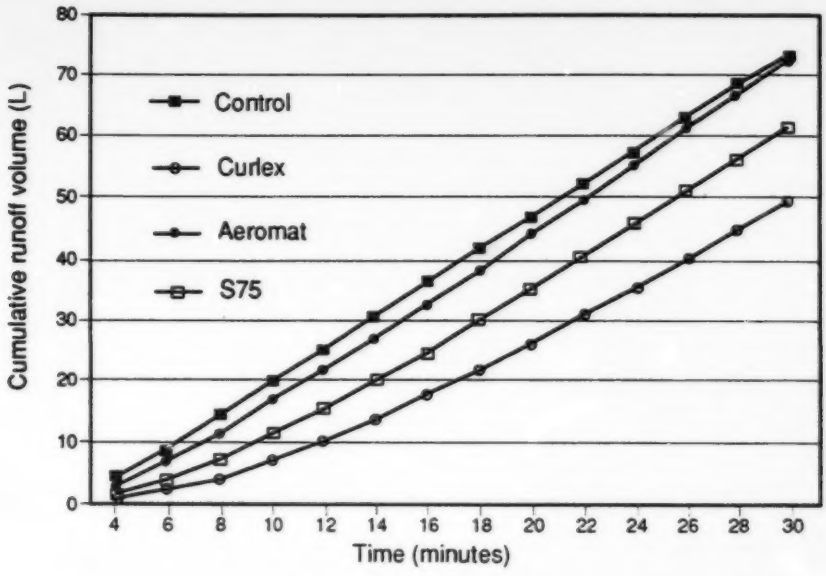


Figure 3/ Runoff from erosion control blanket plots

Table 4/ Percent reduction in soil loss with erosion control products relative to the control plots

Sample Time (min)	Mulches				Blankets		
	Conwed	Ecofibre	Verdyol	Hydromulch	Curlex	Aeromat	S75
2	97	95	93	-	-	-	-
4	95	93	83	93	100	100	100
6	91	88	74	98	99	100	97
8	85	76	72	98	99	99	95
10	85	72	61	99	97	99	93
12	91	71	54	98	93	98	88
14	80	80	56	97	95	99	90
16	87	79	63	98	92	99	91
18	78	64	37	98	82	98	77
20	80	44	31	98	93	98	80
22	79	50	39	98	86	98	83
24	89	65	55	97	87	97	76
26	87	65	45	95	88	97	77
28	90	75	34	96	85	98	81
30	87	68	54	95	87	98	80

about the same as the control plot. The Aeromat product reduces runoff for the initial 10 minutes of rainfall but then tends to yield greater amounts of runoff than the control plots for the remainder of the event.

Statistical analysis of the runoff data is reported in Table 3. For most of the return periods reported, the runoff volumes from the Curlex product are significantly lower than those for the control plots. Runoff from the Aeromat plots and the S75 plots are not usually significantly different from the control plots.

4.2/ Sediment Concentration

4.2.1/ Erosion Control Mulches

The sediment concentration in runoff from the mulched plots, during the rainfall event, is shown in Figure 4. All of the raw data are reported in Appendix B. The sediment concentrations for the two control plots approximated 20 g L^{-1} for much of the rainfall event, while the sediment concentrations from the mulched plots were less. Statistical analysis of the data revealed that while each of the sediment concentrations for the mulched plots differed significantly from the control, there was usually no significant difference between the respective mulch products (Table 3).

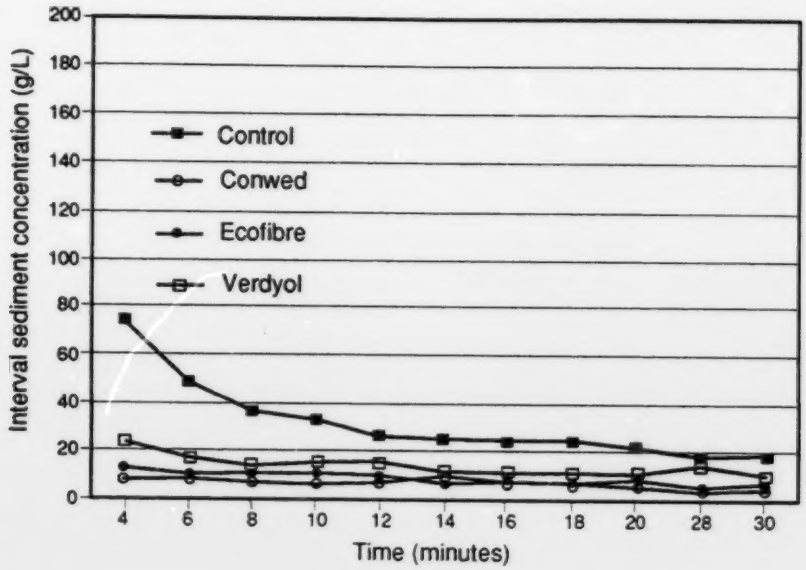
4.2.2/ Erosion Control Blankets

Sediment concentrations from runoff for the erosion control blanket plots (Figure 5) are all less than 20 g L^{-1} and analogous to values reported for the erosion control mulches. The control plots had high relative sediment concentration values that ranged from 60 to 190 g L^{-1}. Statistical analysis indicated that each of the blanket products had sediment concentrations that were significantly different from each other.

4.3/ Soil Loss

4.3.1/ Erosion Control Mulches

Soil loss from the erosion control mulch plots are shown in Figure 6, and all the raw data are shown in Appendix B. Each of the erosion control mulches employed resulted in soil loss reduction (Figure 6). Cumulative soil loss from the control plots approached approximately 2 000 g, and soil loss from mulched plots were all less than 1 000 g by the end of the rainfall event. Table 4 illustrates the percent of reduction in soil loss obtained with the mulch products. The Albion Hills hydromulch reduces soil loss relative to the control plot by >90% for the entire rainfall event, while the Conwed mulch reduced soil loss by >80% for much of the rainfall event. The Ecofibre and Verdyol were less effective in reducing soil loss, 60-70% and 30-40%, respectively.



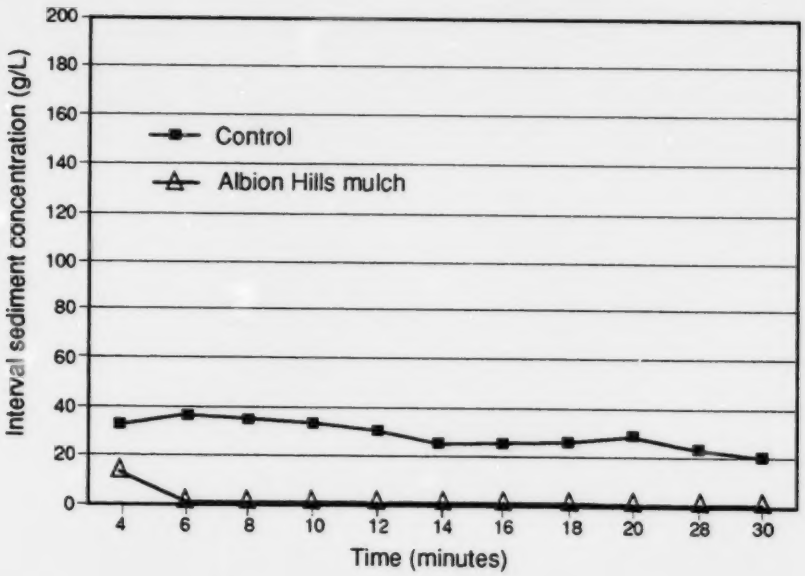


Figure 4/ Sediment concentration in runoff from erosion control mulch plots

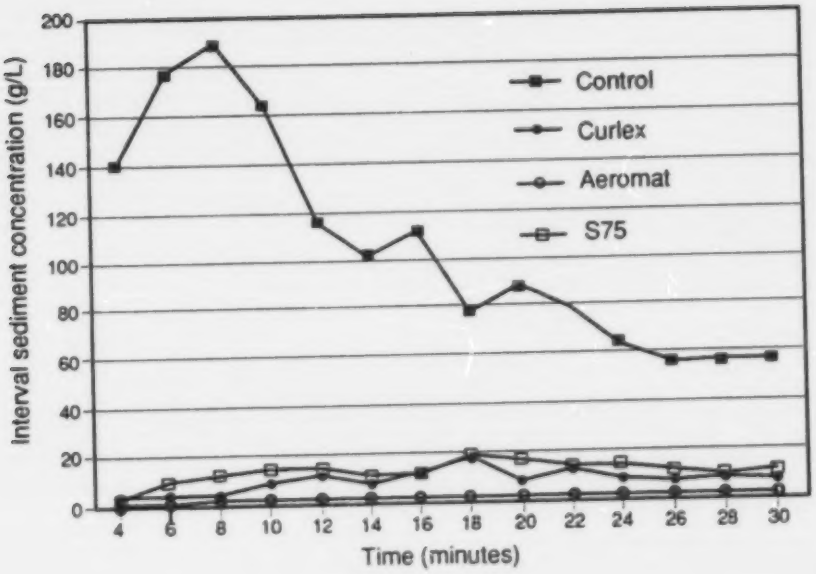


Figure 5/ Sediment concentration in runoff from erosion control blanket plots

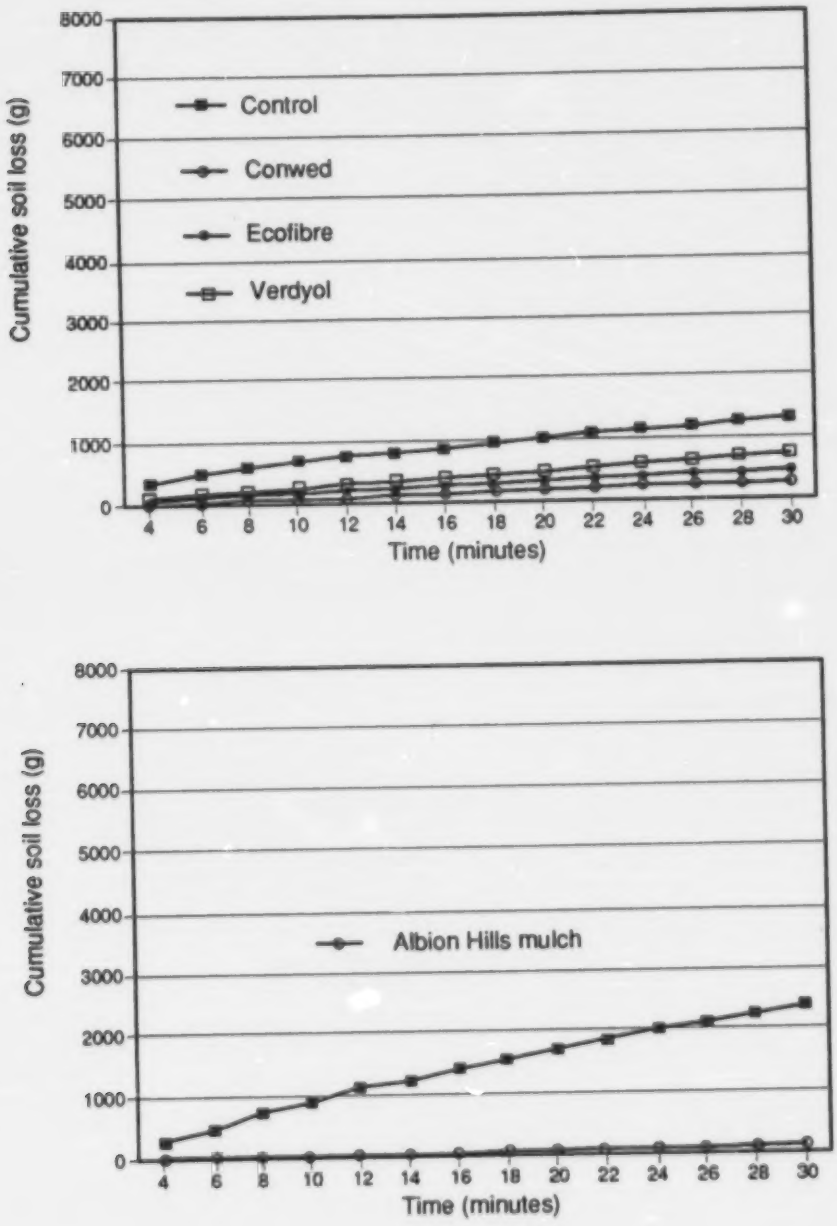


Figure 6/ Soil loss from erosion control mulch plots

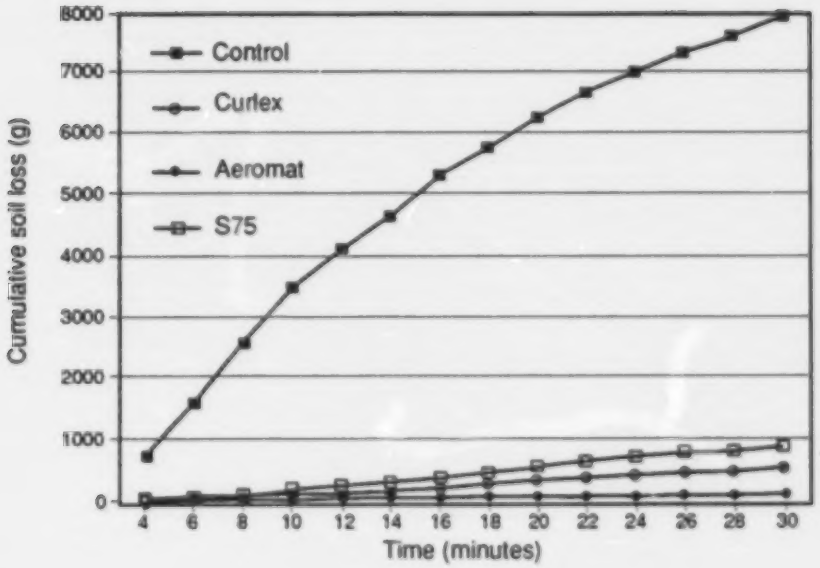


Figure 7/ Soil loss from erosion control blanket plots

Statistical analysis of soil loss data revealed that while all mulch products significantly (P=0.05) reduced soil loss relative to the control plot, there were no statistically significant differences between the mulch products (Table 3).

4.3.2/ Erosion Control Blankets

Soil loss from the erosion control blanket plots and associated control plots are shown in Figure 7. The control plot lost approximately 8 000 g of soil during the rainfall event. This soil loss level is approximately four times greater than soil loss from the other control sites. However, soil loss from the erosion control blanket plots are all <1 000 g for the rainfall event. Use of the Aeromat blanket appears to result in greatest soil loss reduction followed by the Curlex and S75 products, respectively. The Aeromat blanket reduced soil loss relative to the control plot by >90% for the entire rainfall event (Table 4). The Curlex blanket reduced soil loss by >90% for much of the first 20 minutes of the event before falling to >80% for the last 10 minutes of the event. The S75 reduced soil loss by >90% early in the event but fell to >80% by mid-event, and to >70% by the end of the rainfall.

Statistical analysis indicated that all the erosion control blankets reduced runoff significantly relative to the control. However there were no significant differences between the erosion control blankets (Table 3).

4.4/ Soil Loss Ratios (VM)

The ratio of soil loss from a conservation treatment relative to soil loss from bare soil conditions has proven to be a useful method to quantitatively evaluate the relative effectiveness of erosion control products (Clyde, 1976). A soil loss ratio (VM or C factor) can be computed from the soil loss data obtained in this study for any rainfall period up to 30 minutes (ie. up to about a 250+ year return period storm).

4.4.1/ Erosion Control Mulches

Table 5 reports VM values for the erosion control products studied during seven selected return period storms. Data from the 1989 testing of Fibramulch (Mulch Type C) [1] are included in Table 5 and are discussed in relation to the performance of the four mulches in this paper. VM values for the erosion control mulches range from 0.029 to 0.362, and tend to increase in value with the severity of the rainfall event. A relative ranking of the erosion control mulches in terms of the VM factor with greatest erosion control listed first would be as follows: Albion Hills hydromulch > Fibramulch > Conwed > Ecofibre > Verdyol.

4.4.2/ Erosion Control Blankets

Table 5 also reports the VM values for the erosion control blankets. Each of the erosion control blankets tested afforded greater soil erosion protection than the erosion control mulches. VM values

Table 5/ VM values for erosion control products

Sample Time (min)	Corresponding Storm Return Period	Mulches				Blankets			Blanket* Aeromat	Mulch* Type 'C' (Fibra-mulch)
		Conwed	Ecofibre	Verdyol	Hydromulch	Curlex	Aeromat	S75		
4	5	0.042	0.063	0.138	0.067	0.003	0.004	0.004	0.015	0.031
6	10	0.055	0.079	0.174	0.050	0.005	0.004	0.017	0.012	0.028
10	25	0.082	0.130	0.219	0.030	0.013	0.007	0.040	0.009	0.036
12	50	0.083	0.146	0.244	0.028	0.021	0.008	0.051	0.009	0.049
16	100	0.096	0.156	0.270	0.028	0.032	0.009	0.061	0.009	0.070
20	200	0.106	0.181	0.303	0.026	0.045	0.011	0.083	0.008	0.090
30	250+	0.110	0.214	0.362	0.029	0.064	0.014	0.108	0.009	0.118

**Data reported by Armstrong and Wall, 1990*

ranged from 0.003 to 0.108. All of the blanket products were initially effective in minimizing soil loss. However, as the blanket became increasingly saturated over time, the soil loss continued to increase. A relative ranking of the erosion control blanket products in terms of the VM factor would be Aeromat > Curlex > S75.

4.5/ Stability of Erosion Control Mulches

During each of the rainfall simulation events, the erosion control mulch products were visually monitored to determine any point in time when the erosion control products became ineffective. However, none of the erosion control mulch products studied appeared to approach a point of significant failure during the 30 minute rainfall event. The only erosion control product observed clearly in the runoff water was the Albion Hills hydromulch, easily recognized by its dark green colour. An attempt was made to screen out the hydromulch and subsequently weigh the material, but the resulting data did not indicate at which point, during the runoff event, the hydromulch failed. A time series of photographs for the Albion Hills hydromulch runoff event are found in Appendix A.

The suspended sediment concentration of the runoff was studied as a further index of the stability of the erosion control mulch products. It was hypothesized that any major failures of the erosion control mulch products would be accompanied by abrupt changes in the sediment concentration of the runoff. Figure 8 shows the suspended sediment concentrations of the four erosion control mulch products studied over the rainfall event. There is no suggestion from this data that any of the products have reached a point of significant failure.

5/ Summary and Conclusions

The effectiveness of seven temporary soil erosion control products, used in highway construction erosion control, were evaluated quantitatively. Each of the products were subjected to simulated rainfall at an intensity of 2.67 mm min^{-1} for 30 minutes. Runoff and soil loss from the event were measured at two-minute intervals so that the effectiveness of the erosion control product could be evaluated with time. A range of rainfall intensity-durations equivalent to 2 to 250+ year return period storms, or rainfall energies (EI), of 100 to 3000 MJ mm ha^{-1} h^{-1} was used.

Each of the erosion control products were evaluated at highway construction locations on 2:1 slopes, prepared and installed to MTO specifications. The erosion control products studied included three erosion control blankets (Aeromat, Curlex, S75) and four erosion control mulches (Conwed, Ecofibre, Albion Hills hydromulch, Verdyol).

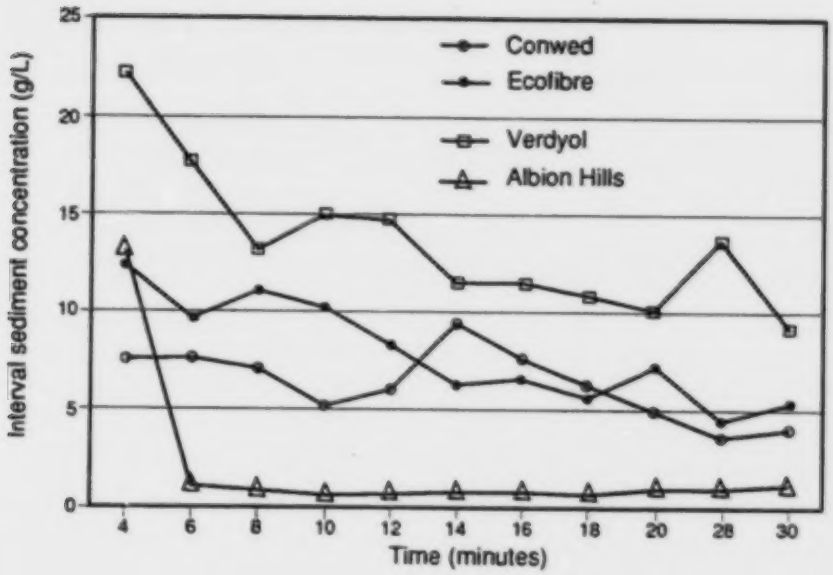


Figure 8/ Sediment concentration with time from erosion control mulches

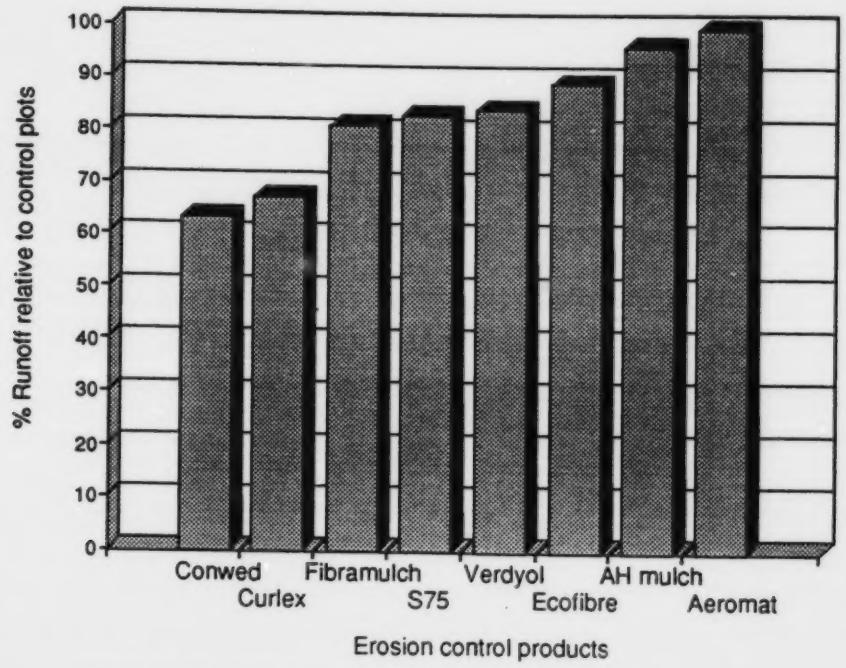


Figure 9/ Percentage of runoff from erosion control products relative to the control

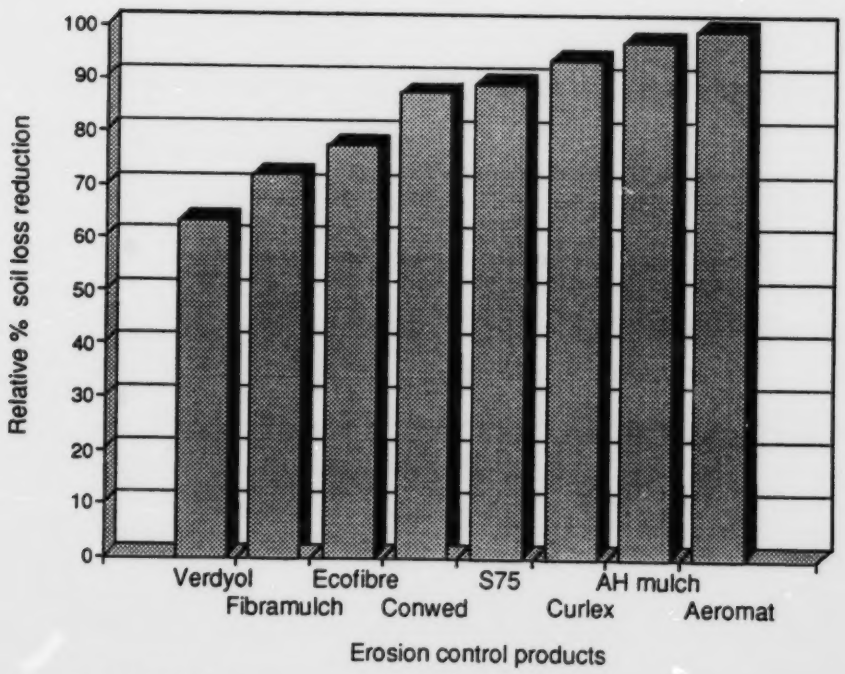


Figure 10/ Percentage of soil loss from erosion control products relative to the control

All of the erosion control products studied reduced total runoff volumes relative to the bare soil control plots. Figure 9 illustrates the relative runoff reduction obtained by the seven erosion control products. The Curlex and Conwed products were most effective in reducing runoff; S75, Verdyol and Ecofibre were moderately effective; and Albion Hills hydromulch and Aeromat were least effective.

The effectiveness of the erosion control products in reducing runoff volumes also varied with time over the rainfall event. The erosion control mulches (Conwed, Ecofibre, Verdyol) reduced runoff volumes for the initial 15 minutes of the storm, but produced runoff volumes analogous to the bare soil control plots for the final 15 minutes of the event. The Albion Hills hydromulch was similar to the control plot throughout the rainfall event.

The erosion control blankets also varied with time in runoff control. The Aeromat and S75 products reduced runoff relative to the control plots for the initial 10 and 20 minutes of the rainfall event, respectively. For the remainder of the event, runoff volumes were usually equal to, or greater than that for the bare control plots. The Curlex product reduced runoff volumes throughout the entire rainfall event.

Many of these erosion control products studied produce high percentages of runoff in rainfall events. When these products are recommended for soil erosion control at a given site, plans should also be included to accommodate the high runoff volumes that may occur downslope.

The erosion control products were all effective in reducing soil loss relative to the bare soil control plots. Figure 10 illustrates the relative effectiveness of the products in reducing soil erosion. The most effective products in controlling soil erosion were the Albion Hills hydromulch and the Aeromat blanket. The Conwed, Curlex and S75 products were moderately effective while the Fibramulch, Ecofibre and Verdyol products were least effective in controlling soil erosion.

The VM values for the erosion control blankets ranged from 0.003 to 0.108 depending upon the duration of the rainfall event. Similarly, the VM values for the erosion control mulches ranged from 0.028 to 0.362. These measured VM values correspond to values reported in the literature.

6/ Study Team

The following study team members are acknowledged for their assistance in field data collection, laboratory analysis, data synthesis, and report preparation: I.J. Shelton, D.J. King, B.K. Hohner, and S.F. Duvieusart.

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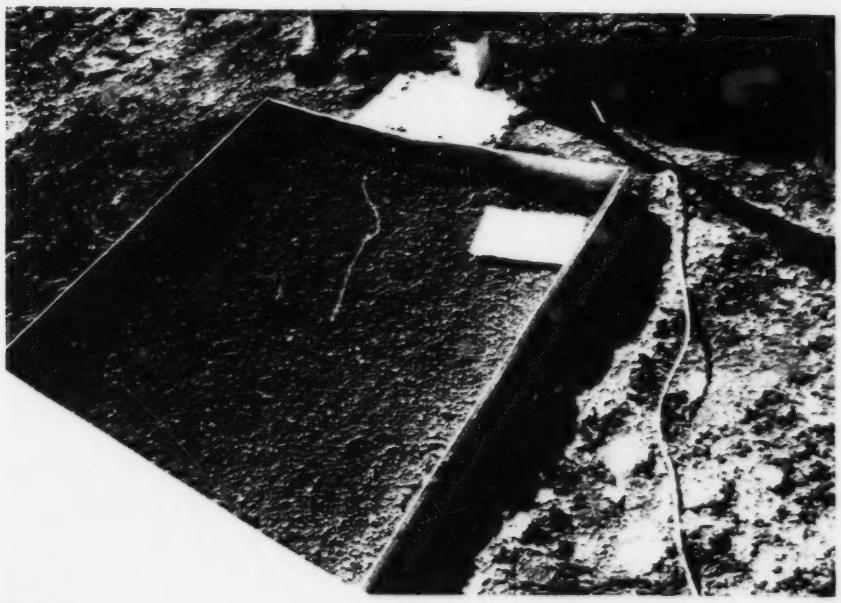
Appendix A

Photographs of Study Sites and Erosion Control Products

Toronto Site



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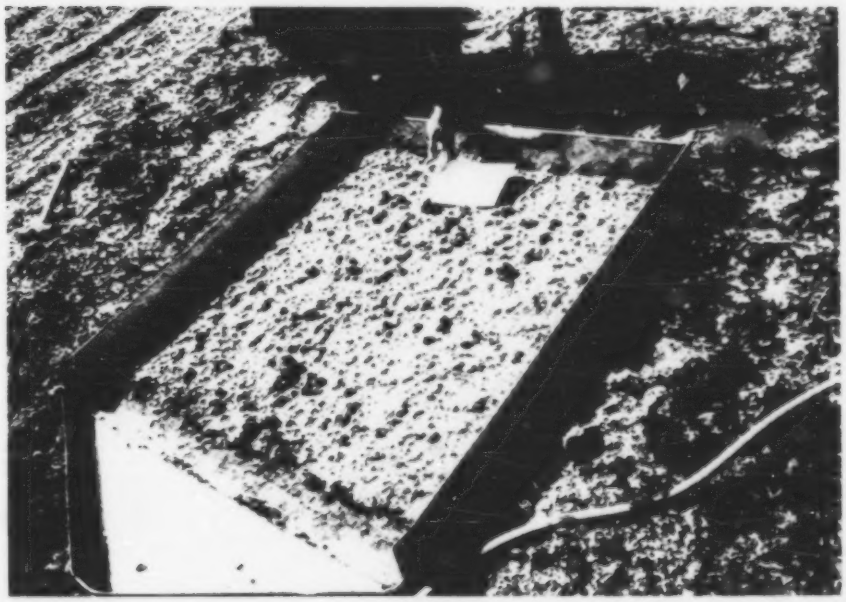
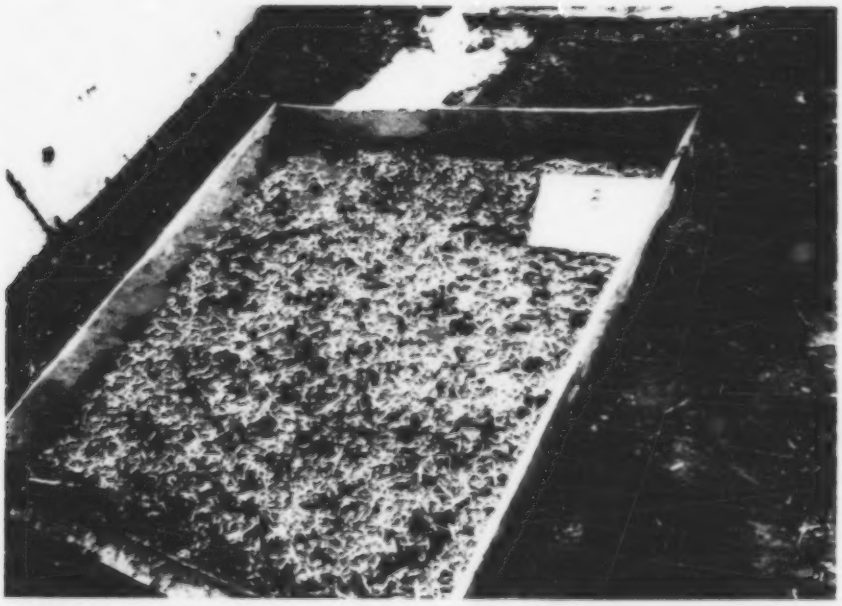
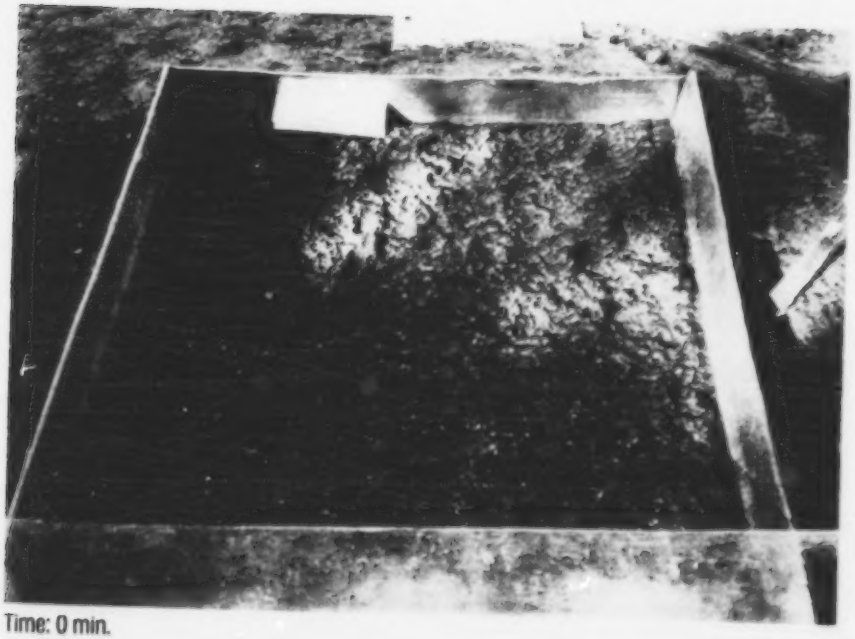


Conwed



Verdyol

Albion Hills Hydromulch



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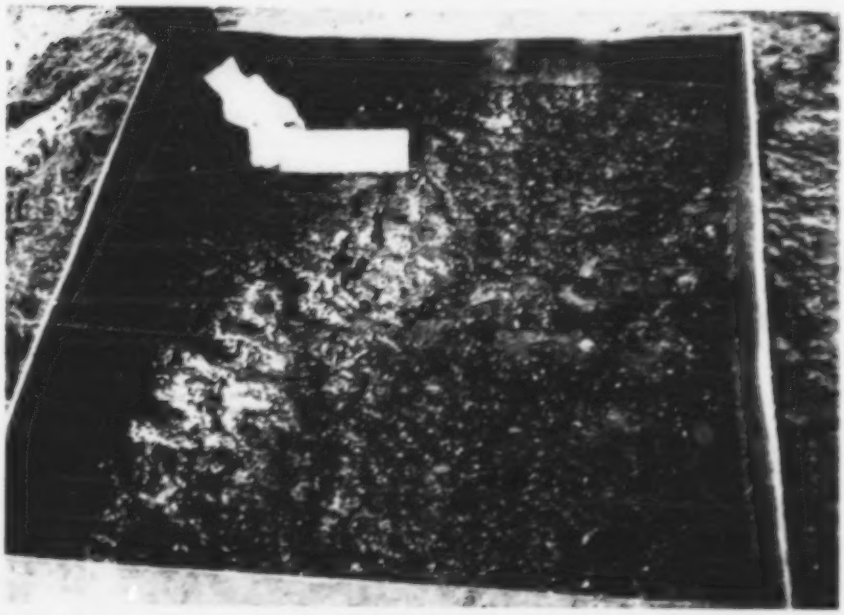

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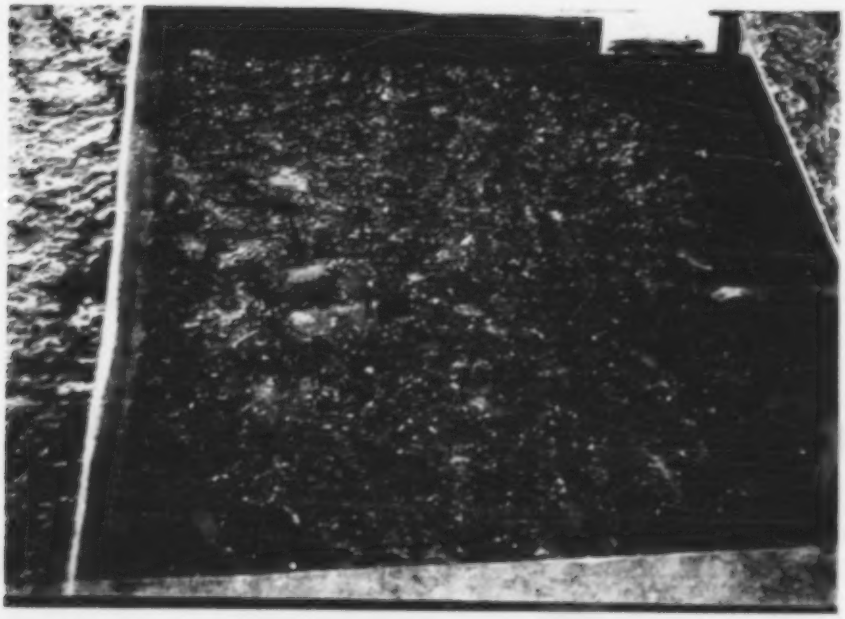

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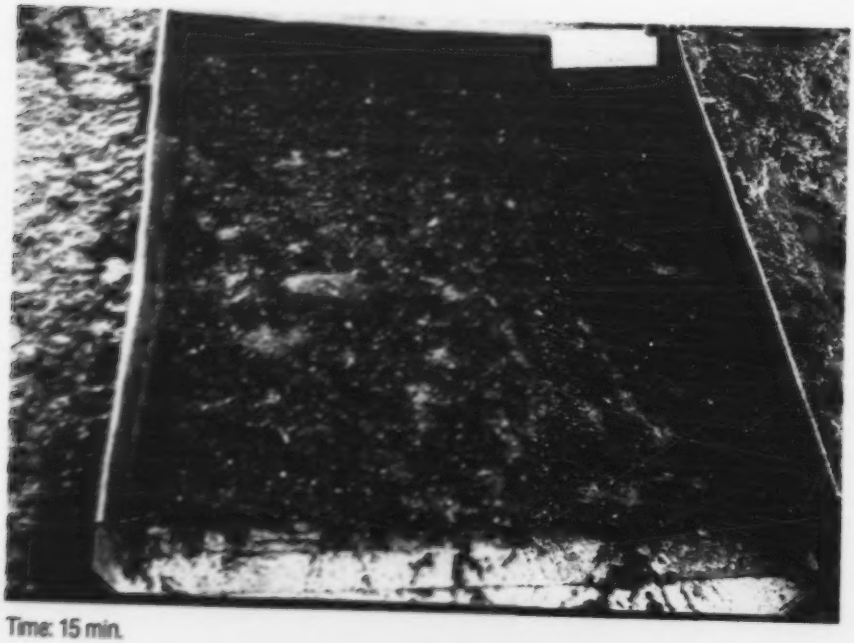

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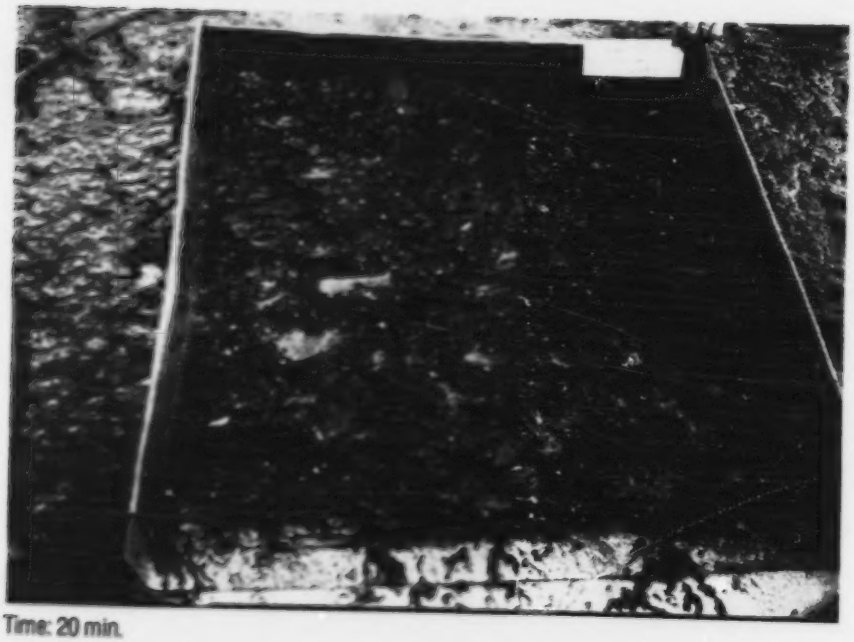

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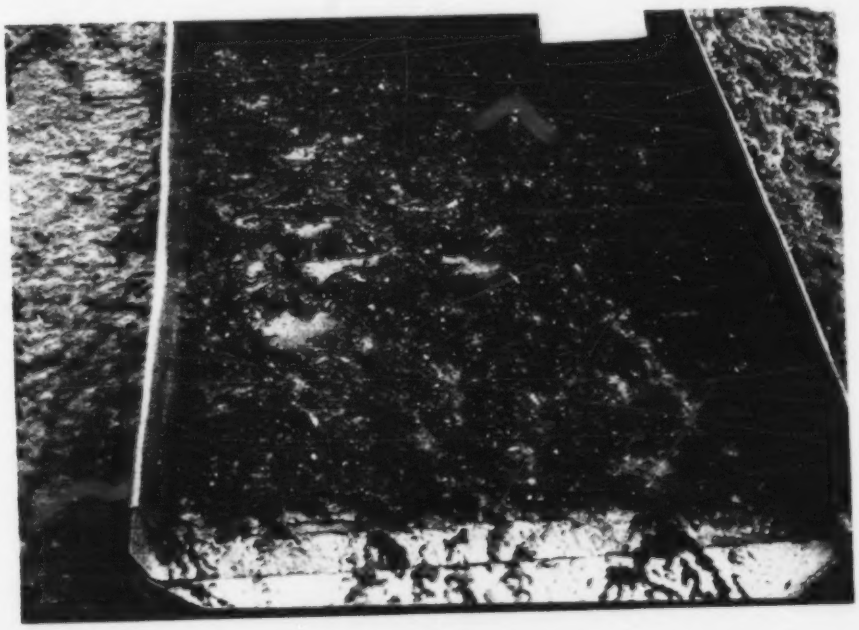

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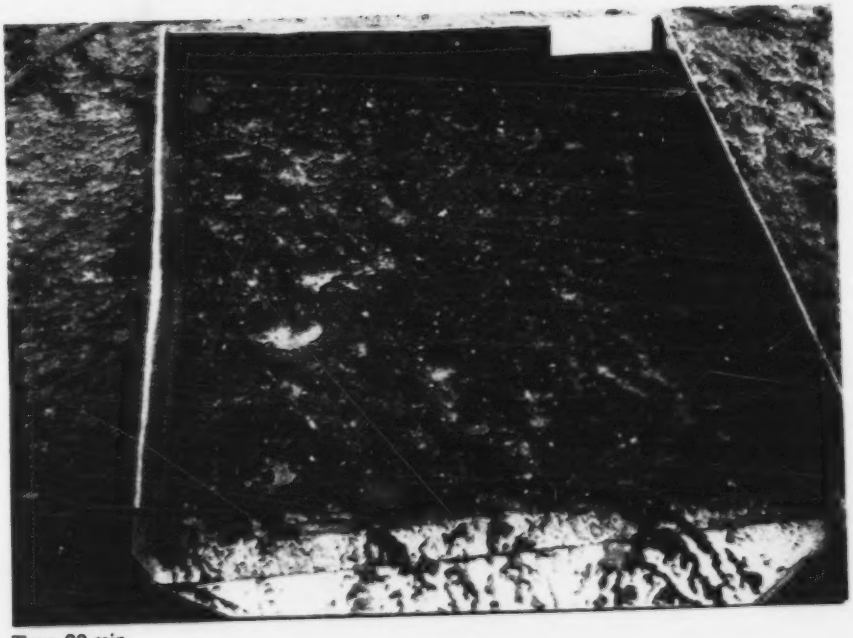
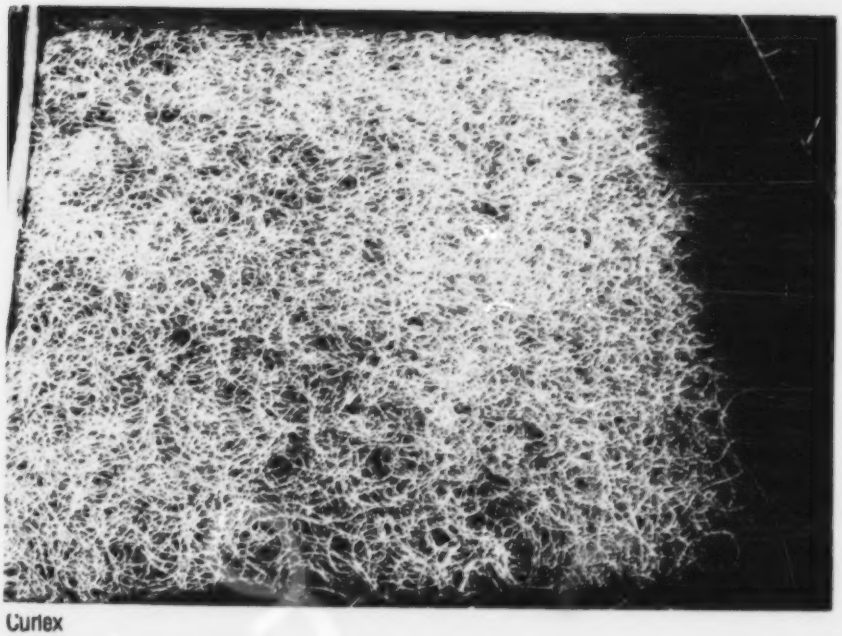


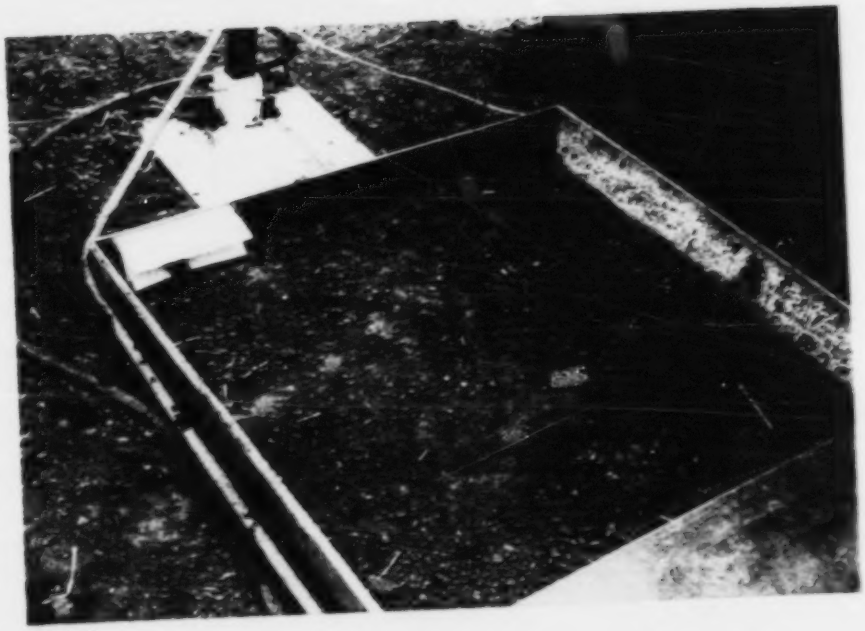
Time: 30 min.

S 75

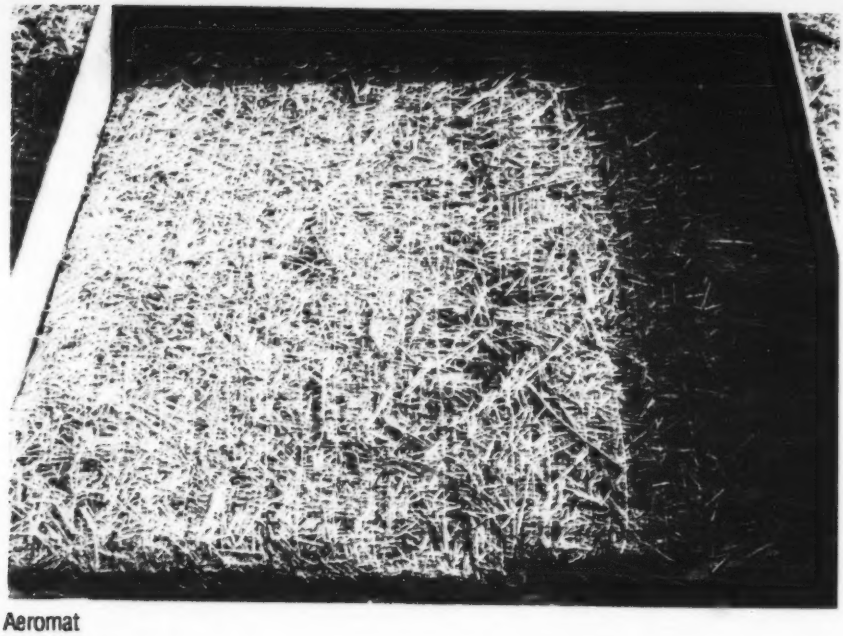


Curlex

Waterloo Site



Control



Aeromat

Appendix B

Plot Data for Runoff, Sediment Concentration, and Soil Loss for the Study Sites

Site: Toronto
September 29, 1990

Sediment Concentration (Sed Con)

Plot: Control P3
Rep 1

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
2	139.8	139.8	1.04	1.04	145.4	145.4
4	87.1	226.9	4.30	5.34	374.5	519.9
6	63.1	290.0	4.35	9.69	274.5	794.4
8	41.8	331.8	4.08	13.77	170.3	964.7
10	32.3	364.0	4.14	17.91	133.5	1098.3
12	29.3	393.3	4.70	22.61	137.5	1235.7
14	23.1	416.3	4.38	26.99	101.0	1336.7
16	22.1	438.4	4.51	31.50	99.4	1436.1
18	21.1	459.5	4.18	35.68	88.2	1524.3
20	21.7	481.1	3.65	39.33	79.0	1603.4
22	16.9	498.0	4.40	43.73	74.4	1677.7
24	18.0	516.0	4.50	48.23	80.8	1758.5
26	19.0	535.0	4.47	52.70	84.9	1843.4
28	15.1	550.1	4.88	57.58	73.7	1917.1
30	14.5	564.5	4.40	61.98	63.6	1980.7

Rep 2

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
2	99.9	99.9	2.30	2.30	229.7	229.7
4	75.5	175.4	5.22	7.52	394.1	623.8
6	33.5	208.9	5.30	12.82	177.6	801.3
8	26.3	235.2	4.94	17.76	129.9	931.2
10	31.5	266.7	3.82	21.58	120.3	1051.6
12	20.5	287.2	4.09	25.67	83.8	1135.4
14	22.8	310.0	3.91	29.58	89.1	1224.6
16	23.0	333.0	4.51	34.09	103.8	1328.4
18	23.4	356.4	5.59	39.68	130.8	1459.2
20	21.6	378.0	3.88	43.56	83.8	1543.0
22	18.8	396.8	4.54	48.10	85.2	1628.3
24	17.3	414.1	5.88	53.98	101.7	1730.0
26	19.0	433.0	4.12	58.10	78.1	1808.1
28	19.2	452.2	4.58	62.68	87.7	1895.8
30	19.2	471.3	4.83	67.51	92.5	1988.3

Rep 3

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
2	84.1	84.1	1.50	1.50	126.2	126.2
4	62.4	146.5	4.74	6.24	295.5	421.7
6	47.7	194.2	4.61	10.85	219.9	641.6
8	38.5	232.6	4.72	15.57	181.5	823.1
10	33.4	266.0	4.76	20.33	158.7	981.8
12	28.1	294.1	5.12	25.45	143.9	1125.7
14	28.3	322.3	4.24	29.69	119.8	1245.5
16	24.0	346.3	4.90	34.59	117.6	1363.1
18	25.7	372.0	4.71	39.30	121.0	1484.1
20	21.6	393.6	4.76	44.06	102.6	1586.7
22	20.7	414.2	4.59	48.65	94.8	1681.5
24	19.1	433.3	4.03	52.68	77.0	1758.4
26	20.0	453.3	3.98	56.66	79.4	1837.9
28	21.4	474.7	4.75	61.41	101.7	1939.5
30	18.5	493.1	4.66	66.07	86.0	2025.5

Plot: Conwed
Rep 1

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
2	6.9	6.9	0.64	0.64	4.4	4.4
4	4.0	10.9	2.10	2.74	8.4	12.8
6	3.4	14.3	2.90	5.64	9.9	22.7
8	3.1	17.4	3.33	8.97	10.4	33.1
10	2.5	19.9	3.60	12.57	8.9	42.0
12	2.6	22.5	3.57	16.14	9.4	51.3
14	2.4	24.9	3.96	20.10	9.3	60.7
16	2.1	26.9	4.07	24.17	8.5	69.1
18	3.1	30.0	4.50	28.67	13.8	82.9
20	2.5	32.5	4.51	33.18	11.1	94.0
22	2.7	35.2	4.84	38.02	13.1	107.1
24	2.1	37.3	4.56	42.58	9.6	116.7
26	2.6	39.9	4.08	46.66	10.7	127.3
28	2.0	41.9	4.50	51.16	8.9	136.3
30	2.1	43.9	4.90	56.06	10.2	146.4

Rep 2

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
2	7.5	7.5	0.46	0.46	3.5	3.5
4	11.1	18.6	1.31	1.77	14.5	17.9
6	11.8	30.3	1.68	3.45	19.8	37.7
8	11.1	41.4	1.96	5.41	21.7	59.4
10	7.8	49.2	2.38	7.79	18.5	77.9
12	9.1	58.3	2.70	10.49	24.6	102.5
14	16.4	74.7	3.24	13.73	53.1	155.7
16	12.9	87.6	3.18	16.91	41.0	196.6
18	9.1	96.7	3.43	20.34	31.3	227.9
20	7.1	103.8	3.45	23.79	24.6	252.5
22	6.1	110.0	3.55	27.34	21.8	274.3
24	4.9	114.9	3.67	31.01	18.1	292.4
26	5.5	120.4	3.84	34.85	21.0	313.4
28	4.8	125.2	3.42	38.27	16.3	329.8
30	5.3	130.5	3.76	42.03	20.1	349.8

Plot: Ecofibre
Rep 1

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
2	43.3	43.3	0.50	0.50	21.7	21.7
4	28.7	72.0	1.99	2.49	57.0	78.7
6	20.6	92.6	2.88	5.37	59.2	137.9
8	15.2	107.8	3.78	9.15	57.5	195.4
10	10.1	117.9	4.07	13.22	41.1	236.6
12	10.5	128.4	4.32	17.54	45.3	281.8
14	7.5	135.9	4.44	21.98	33.2	315.0
16	8.4	144.3	3.47	25.44	29.2	344.3
18	7.2	151.5	4.54	29.98	32.6	376.9
20	7.8	159.2	4.82	34.80	37.4	414.3
22	7.0	166.2	4.82	39.62	33.5	447.8
24	7.3	173.5	4.81	44.43	35.2	483.0
26	6.1	179.6	4.88	49.31	29.8	512.8
28	3.9	183.5	4.98	54.29	19.2	532.0
30	5.5	189.0	5.07	59.36	27.8	559.8

Rep 2

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
2	6.4	6.4	0.51	0.51	3.2	3.2
4	4.6	10.9	1.88	2.39	8.6	11.8
6	5.5	16.4	2.52	4.91	13.9	25.7
8	15.1	31.5	3.28	8.19	49.5	75.2
10	13.5	45.0	3.90	12.09	52.7	127.8
12	10.6	55.6	4.30	16.39	45.4	173.2
14	7.0	62.5	4.06	20.45	28.3	201.5
16	5.9	68.5	4.78	25.23	28.3	229.8
18	5.2	73.6	5.26	30.49	27.1	256.9
20	7.2	80.8	5.25	35.74	37.9	294.8
22	4.8	85.7	5.41	41.15	26.1	320.9
24	5.6	91.2	5.13	46.28	28.5	349.4
26	6.3	97.5	5.72	52.00	36.2	385.6
28	5.5	103.1	5.66	57.66	31.2	416.8
30	5.0	108.1	1.46	59.12	29.3	446.2

Rep 3

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
2	2.8	2.8	0.43	0.43	1.2	1.2
4	4.1	6.9	1.50	1.93	6.2	7.4
6	3.1	10.0	2.17	4.10	6.7	14.0
8	2.8	12.8	2.87	6.97	8.0	22.1
10	6.9	19.6	3.13	10.10	21.5	43.5
12	3.9	23.5	3.49	13.59	13.6	57.2
14	3.9	27.4	3.42	17.01	13.3	70.5
16	5.4	32.8	3.60	20.61	19.3	89.8
18	4.2	37.0	3.90	24.51	16.5	106.3
20	6.1	43.2	4.24	28.75	26.0	132.3
22	5.7	48.8	4.43	33.18	25.1	157.4
24	5.7	54.6	4.52	37.69	25.8	183.2
26	4.1	58.6	4.53	42.22	18.5	201.7
28	3.8	62.4	4.36	46.58	16.6	218.3
30	4.6	67.1	4.48	51.06	20.7	239.0

Plot: Verdyol
Rep 1

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
2	7.8	7.8	1.24	1.24	9.6	9.6
4	8.3	16.1	2.92	4.16	24.2	33.8
6	8.7	24.8	3.20	7.36	27.9	61.7
8	7.5	32.3	3.35	10.71	25.2	86.9
10	7.8	40.1	3.49	14.20	27.2	114.1
12	5.4	45.5	3.79	17.99	20.4	134.5
14	6.7	52.2	4.08	22.07	27.4	161.9
16	6.6	58.8	4.05	26.12	26.9	188.8
18	7.6	66.4	3.91	30.03	29.7	218.5
20	6.2	72.7	3.98	34.01	24.8	243.4
22	5.5	78.2	4.07	38.08	22.3	265.7
24	6.9	85.1	3.94	42.02	27.3	293.0
26	6.3	91.4	4.11	46.13	26.1	319.1
28	7.9	99.3	4.15	50.27	32.7	351.8
30	6.8	106.2	4.08	54.35	27.9	379.7

Rep 2

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
2	8.0	8.0	0.52	0.52	4.1	4.1
4	17.9	25.9	2.55	3.07	45.7	49.8
6	15.0	40.9	3.00	6.07	45.1	95.0
8	12.4	53.4	3.14	9.21	39.0	134.0
10	14.3	67.6	3.32	12.53	47.3	181.3
12	12.6	80.2	3.64	16.17	45.8	227.1
14	11.5	91.7	3.89	20.06	44.8	271.9
16	13.0	104.7	3.82	23.88	49.7	321.6
18	9.7	114.5	3.87	27.75	37.7	359.3
20	10.4	124.9	4.00	31.75	41.8	401.0
22	11.0	135.9	4.93	36.68	54.0	455.1
24	11.6	147.5	3.77	40.45	43.8	498.9
26	11.2	158.7	4.48	44.93	50.2	549.0
28	7.7	166.3	4.07	49.00	31.2	580.2
30	9.8	176.2	4.02	53.02	39.6	619.8

Rep 3

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
2	38.9	38.9	0.51	0.51	19.8	19.8
4	40.7	79.6	2.76	3.27	112.2	132.1
6	29.4	108.9	3.41	6.68	100.1	232.2
8	19.6	128.5	3.64	10.32	71.3	303.5
10	22.8	151.3	3.84	14.16	87.4	390.9
12	26.1	177.4	3.92	18.08	102.2	493.1
14	16.0	193.4	4.08	22.16	65.4	558.4
16	14.6	208.0	4.18	26.34	60.9	619.4
18	14.7	222.7	4.38	30.72	64.5	683.9
20	13.1	235.8	4.43	35.15	58.2	742.1
22	18.5	254.3	4.32	39.47	79.7	821.8
24	10.1	264.4	4.46	43.93	45.0	866.8
26	13.1	277.4	4.32	48.25	56.4	923.2
28	24.8	302.3	4.41	52.66	109.5	1032.7
30	10.4	312.7	4.33	56.99	45.0	1077.8

Site: Albion Hill
November 18, 1990

Plot: Control
Rep 1

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	24.1	24.1	6.89	6.89	166.0	166.0
6	20.2	44.3	4.87	11.76	98.4	264.4
8	34.6	78.9	5.46	17.22	188.9	453.3
10	25.1	104.0	5.04	22.26	126.5	579.8
12	22.5	126.6	5.13	27.39	115.7	695.5
14	17.3	143.9	5.70	33.09	98.6	794.1
16	20.3	164.2	5.41	38.50	110.1	904.2
18	19.4	183.6	5.22	43.72	101.3	1005.5
20	18.5	202.1	5.40	49.12	99.6	1105.1
22	20.9	223.0	5.52	54.64	115.4	1220.5
24	14.4	237.4	5.55	60.19	79.9	1300.4
26	20.9	258.2	5.40	65.59	112.6	1413.0
28	19.4	277.6	5.56	71.15	107.6	1520.6
30	14.9	292.5	5.55	76.70	83.0	1603.6

Rep 2

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	48.4	48.4	7.95	7.95	384.4	384.4
6	55.1	103.5	5.77	13.72	317.9	702.3
8	99.1	202.6	5.82	19.54	576.8	1279.1
10	39.3	241.9	6.09	25.63	239.3	1518.4
12	35.8	277.6	5.76	31.39	205.9	1724.3
14	30.6	308.2	5.73	37.12	175.1	1899.4
16	31.9	340.1	5.98	43.10	190.8	2090.1
18	32.1	372.2	6.05	49.15	194.5	2284.6
20	36.9	409.1	6.40	55.55	235.8	2520.5
22	30.7	439.7	6.34	61.89	194.3	2714.8
24	25.9	465.6	6.29	68.18	162.9	2877.7
26	23.6	489.2	5.92	74.10	139.4	3017.1
28	28.0	517.2	6.07	80.17	170.0	3187.1
30	21.4	538.5	5.75	85.92	122.8	3309.9

Rep 3

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	26.5	26.5	7.10	7.10	188.2	188.2
6	34.7	61.2	2.93	10.03	101.5	289.7
8	37.0	98.2	4.29	14.32	158.7	448.4
10	36.4	134.6	5.24	19.56	190.7	639.1
12	36.7	171.3	5.46	25.02	200.4	839.5
14	28.0	199.2	5.11	30.13	142.8	982.3
16	26.5	225.7	5.62	35.75	148.9	1131.3
18	28.8	254.5	5.72	41.47	164.7	1296.0
20	32.0	286.5	5.71	47.18	182.4	1478.4
22	33.4	319.8	5.56	52.74	185.4	1663.9
24	28.7	348.5	5.31	58.05	152.1	1816.0
26	24.1	372.6	5.22	63.27	126.1	1942.1
28	24.2	396.8	5.44	68.71	131.6	2073.7
30	25.9	422.8	5.24	73.95	136.0	2209.7

Plot: Mulch
Rep 1

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	36.5	36.5	1.12	1.12	40.9	40.9
6	1.7	38.2	3.28	4.40	5.5	46.4
8	0.5	38.7	4.10	8.50	2.0	48.5
10	0.5	39.2	4.03	12.53	1.9	50.3
12	0.4	39.5	4.98	17.51	1.8	52.1
14	0.4	40.0	4.96	22.47	2.1	54.2
16	0.3	40.3	5.12	27.59	1.6	55.9
18	0.3	40.6	5.32	32.91	1.7	57.6
20	0.4	41.0	5.64	38.55	2.5	60.0
22	0.3	41.3	5.56	44.11	1.4	61.5
24	0.3	41.6	5.87	49.98	2.0	63.5
26	0.2	41.9	5.64	55.62	1.4	64.8
28	0.2	42.1	5.50	61.12	1.3	66.2
30	0.7	42.8	5.66	66.78	4.0	70.1

Rep 2

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	0.6	0.6	2.66	2.66	1.7	1.7
6	0.4	1.1	4.35	7.01	1.9	3.6
8	0.4	1.5	4.87	11.88	1.9	5.5
10	0.4	1.9	5.88	17.76	2.6	8.1
12	0.8	2.7	5.87	23.63	4.9	13.0
14	0.7	3.5	6.15	29.78	4.4	17.4
16	0.9	4.3	5.84	35.62	5.0	22.4
18	0.6	4.9	6.03	41.65	3.4	25.8
20	0.9	5.8	5.95	47.60	5.2	31.0
22	0.7	6.5	6.02	53.62	4.2	35.3
24	1.2	7.7	6.12	59.74	7.6	42.9
26	1.8	9.5	5.90	65.64	10.7	53.6
28	1.2	10.7	6.29	71.93	7.4	61.0
30	1.1	11.8	5.95	77.88	6.8	67.8

Rep 3

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	1.9	1.9	3.80	3.80	7.3	7.3
6	1.0	2.9	5.74	9.54	5.5	12.8
8	1.4	4.3	5.88	15.42	8.2	21.0
10	0.5	4.8	6.10	21.52	3.2	24.2
12	0.5	5.3	5.79	27.31	3.1	27.3
14	0.8	6.2	6.37	33.68	5.2	32.6
16	0.6	6.8	5.73	39.41	3.4	36.0
18	0.5	7.3	6.09	45.50	3.2	39.2
20	0.7	8.0	6.63	52.13	4.5	43.7
22	0.4	8.3	5.95	58.08	2.3	45.9
24	0.7	9.0	6.17	64.25	4.2	50.1
26	1.1	10.2	5.88	70.13	6.7	56.8
28	1.0	11.1	6.28	76.41	6.2	63.0
30	0.8	11.9	6.36	82.77	5.0	67.9

Site: Waterloo
November 2, 1990

Plot: Control
Rep 1

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	256.7	256.7	7.15	7.15	1835.3	1835.3
6	188.7	445.4	6.27	13.42	1183.1	3018.5
8	179.1	624.5	6.20	19.62	1110.7	4129.1
10	162.7	787.2	6.70	26.32	1090.0	5219.1
12	113.6	900.8	5.87	32.19	666.8	5885.9
14	92.4	993.2	6.24	38.43	576.3	6462.2
16	102.7	1095.9	6.40	44.83	657.3	7119.5
18	69.3	1165.2	6.18	51.01	428.3	7547.7
20	83.5	1248.7	6.20	57.21	517.7	8065.4
22	67.0	1315.6	5.47	62.68	366.2	8431.7
24	53.9	1369.5	5.93	68.61	319.3	8751.0
26	41.2	1410.6	5.87	74.48	241.6	8992.5
28	41.4	1452.0	6.47	80.95	267.7	9260.2
30	49.3	1501.3	5.84	86.78	287.7	9547.9

Rep 2

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	113.4	113.4	2.49	2.49	282.4	282.4
6	202.8	316.2	4.83	7.32	979.3	1261.6
8	192.3	508.4	5.50	12.82	1056.4	2318.1
10	140.3	648.7	5.06	17.88	709.7	3027.7
12	102.0	750.6	4.98	22.86	507.7	3535.4
14	93.3	843.9	5.00	27.86	466.3	4001.7
16	114.4	958.3	6.25	34.10	714.4	4716.1
18	76.0	1034.2	5.21	39.31	395.3	5111.4
20	67.6	1101.8	5.05	44.36	341.4	5452.8
22	69.1	1170.9	5.09	49.45	351.7	5804.5
24	59.6	1230.5	4.93	54.38	293.6	6098.1
26	51.8	1282.2	4.84	59.22	250.7	6348.8
28	53.0	1335.2	5.01	64.23	265.5	6614.4
30	51.2	1386.5	4.94	69.17	253.2	6867.5

Rep 3

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	45.9	45.9	1.12	1.12	51.4	51.4
6	140.0	185.9	3.41	4.53	477.4	528.8
8	196.7	382.6	4.47	9.00	879.5	1408.2
10	186.2	568.9	5.04	14.04	938.7	2346.9
12	132.7	701.5	4.91	18.95	651.3	2998.2
14	118.8	820.3	5.02	23.97	596.4	3594.6
16	120.0	940.3	5.68	29.65	681.6	4276.2
18	87.2	1027.5	5.37	35.02	468.3	4744.5
20	115.7	1143.3	4.89	39.91	566.0	5310.5
22	103.3	1246.6	5.36	45.27	553.7	5864.2
24	80.6	1327.1	4.84	50.11	389.9	6254.0
26	74.5	1401.6	5.39	55.50	401.6	6655.6
28	76.8	1478.4	5.41	60.91	415.2	7070.8
30	74.3	1552.6	5.44	66.35	403.9	7474.7

Plot: Curlex
Rep 1

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	0.0	0.0	0.00	0.00	0.0	0.0
6	1.0	1.0	0.18	0.18	0.2	0.2
8	0.7	1.7	0.50	0.68	0.4	0.5
10	1.7	3.4	1.10	1.78	1.9	2.4
12	8.1	11.5	1.70	3.48	13.8	16.3
14	10.2	21.7	2.28	5.76	23.2	39.4
16	6.9	28.6	2.76	8.52	19.2	58.6
18	8.2	36.8	2.96	11.48	24.2	82.7
20	8.2	45.0	3.34	14.82	27.3	110.1
22	11.9	56.8	3.68	18.50	43.6	153.7
24	8.6	65.4	3.80	22.30	32.6	186.3
26	9.4	74.8	4.14	26.44	39.0	225.3
28	9.0	83.8	4.68	31.12	41.9	267.2
30	7.2	91.0	4.44	35.56	31.8	299.0

Rep 2

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	10.9	10.9	0.62	0.62	6.8	6.8
6	3.9	14.8	2.60	3.22	10.1	16.9
8	7.5	22.3	2.68	5.90	20.0	36.9
10	7.7	30.0	4.46	10.36	34.5	71.4
12	9.4	39.4	4.52	14.88	42.3	113.7
14	7.9	47.3	4.90	19.78	38.7	152.5
16	8.8	56.1	4.92	24.70	43.5	195.9
18	7.6	63.8	5.08	29.78	38.8	234.8
20	7.5	71.3	5.26	35.04	39.3	274.1
22	8.2	79.5	5.24	40.28	43.1	317.2
24	10.1	89.6	5.06	45.34	51.3	368.5
26	7.1	96.7	4.97	50.31	35.2	403.7
28	7.0	103.7	5.34	55.65	37.2	440.8
30	6.9	110.6	5.16	60.81	35.7	476.5

Rep 3

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	0.0	0.0	0.11	0.11	0.0	0.0
6	6.0	6.0	0.84	0.95	5.0	5.0
8	4.6	10.6	2.23	3.18	10.3	15.3
10	15.7	26.3	3.34	6.52	52.5	67.8
12	16.9	43.2	3.84	10.36	64.8	132.7
14	4.9	48.1	4.66	15.02	22.9	155.6
16	23.4	71.6	4.44	19.46	104.0	259.6
18	38.4	110.0	4.48	23.94	172.0	431.6
20	8.8	118.7	4.52	28.46	39.6	471.2
22	18.8	137.5	4.54	33.00	85.4	556.6
24	9.1	146.7	4.86	37.86	44.4	601.0
26	5.8	152.5	4.92	42.78	28.7	629.7
28	13.5	166.0	4.74	47.52	63.8	693.5
30	10.9	176.9	5.00	52.52	54.5	748.0

Plot: Aeromat
Rep 1

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	1.1	1.1	2.52	2.52	2.8	2.8
6	1.0	2.1	4.54	7.06	4.5	7.4
8	1.5	3.6	5.78	12.84	8.4	15.8
10	2.0	5.6	6.22	19.06	12.3	28.1
12	1.9	7.4	5.70	24.76	10.6	38.7
14	1.2	8.7	5.90	30.66	7.3	46.0
16	1.7	10.3	6.30	36.96	10.5	56.5
18	1.4	11.7	6.30	43.26	8.8	65.3
20	1.7	13.5	6.58	49.84	11.4	76.8
22	1.8	15.2	6.38	56.22	11.2	88.0
24	2.0	17.2	6.82	63.04	13.6	101.6
26	1.6	18.8	6.66	69.70	10.4	112.0
28	1.5	20.3	6.80	76.50	10.5	122.5
30	1.4	21.7	6.58	83.08	8.9	131.4

Rep 2

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	1.3	1.3	3.44	3.44	4.3	4.3
6	1.4	2.7	4.10	7.54	5.7	10.1
8	1.7	4.4	4.74	12.28	8.1	18.1
10	1.2	5.5	4.92	17.20	5.8	23.9
12	1.1	6.6	5.08	22.28	5.5	29.4
14	1.6	8.3	5.00	27.28	8.2	37.6
16	1.1	9.3	5.02	32.30	5.3	42.9
18	1.0	10.3	5.02	37.32	4.8	47.8
20	1.1	11.4	5.22	42.54	5.6	53.4
22	1.1	12.5	5.28	47.82	5.8	59.2
24	1.1	13.6	5.18	53.00	5.7	64.9
26	1.1	14.7	5.22	58.22	5.7	70.7
28	0.8	15.5	5.22	63.44	4.3	74.9
30	0.9	16.4	5.18	68.62	4.6	79.5

Rep 3

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	1.0	1.0	1.30	1.30	1.3	1.3
6	0.8	1.8	2.25	3.55	1.9	3.2
8	1.6	3.4	3.44	6.99	5.6	8.7
10	1.8	5.2	4.94	11.93	8.7	17.4
12	2.7	7.9	5.50	17.43	14.6	32.1
14	1.5	9.3	5.58	23.01	8.1	40.2
16	1.9	11.3	5.48	28.49	10.6	50.8
18	1.5	12.8	5.60	34.09	8.4	59.2
20	1.7	14.5	5.58	39.67	9.6	68.8
22	2.0	16.5	5.58	45.25	11.4	80.2
24	1.8	18.3	5.46	50.71	9.6	89.8
26	1.6	19.9	5.76	56.47	9.3	99.2
28	1.4	21.3	6.40	62.87	8.8	108.0
30	1.7	23.0	5.38	68.25	9.0	117.0

Plot: S75
Rep 1

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	0.4	0.4	0.25	0.25	0.1	0.1
6	1.4	1.8	1.21	1.46	1.7	1.8
8	2.2	4.0	2.55	4.01	5.6	7.4
10	6.7	10.7	3.37	7.38	22.7	30.1
12	8.2	18.9	3.22	10.60	26.4	56.5
14	9.0	27.9	3.92	14.52	35.2	91.7
16	10.8	38.7	4.04	18.56	43.6	135.3
18	13.7	52.4	4.18	22.74	57.2	192.5
20	12.6	65.0	4.32	27.06	54.6	247.1
22	11.3	76.3	3.94	31.00	44.5	291.6
24	10.3	86.6	4.28	35.28	44.0	335.6
26	11.2	97.8	4.33	39.61	48.3	384.0
28	7.0	104.8	4.18	43.79	29.3	413.3
30	10.2	115.0	4.12	47.91	41.9	455.3

Rep 2

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	2.4	2.4	1.25	1.25	3.0	3.0
6	9.7	12.0	2.22	3.47	21.5	24.5
8	5.2	17.2	3.44	6.91	17.8	42.3
10	7.0	24.3	3.86	10.77	27.2	69.5
12	9.0	33.2	5.36	16.13	48.1	117.6
14	7.5	40.7	5.10	21.23	38.0	155.7
16	9.5	50.2	5.43	26.66	51.4	207.0
18	11.8	62.0	5.99	32.65	70.7	277.7
20	10.1	72.1	6.11	38.76	61.8	339.5
22	11.1	83.2	6.05	44.81	67.0	406.6
24	10.9	94.1	6.41	51.22	70.1	476.7
26	8.8	102.9	6.22	57.44	54.6	531.3
28	7.5	110.4	6.23	63.67	46.8	578.2
30	6.1	116.5	6.51	70.18	39.8	618.0

Rep 3

Sample Time (min)	Interval Sed Con (g/L)	Cumulative Sed Con (g/L)	Interval Runoff (L)	Cumulative Runoff (L)	Interval Soil Loss (g)	Cumulative Soil Loss (g)
4	5.4	5.4	0.93	0.93	5.0	5.0
6	16.7	22.1	3.07	4.00	51.3	56.3
8	27.9	50.0	4.26	8.26	118.7	175.0
10	30.2	80.2	4.87	13.13	147.2	322.2
12	27.1	107.3	5.12	18.25	138.6	460.8
14	17.2	124.5	5.15	23.40	88.8	549.6
16	17.9	142.4	5.27	28.67	94.1	643.7
18	32.5	174.9	5.30	33.97	172.1	815.9
20	28.9	203.8	5.59	39.56	161.8	977.7
22	18.9	222.7	5.49	45.05	103.7	1081.3
24	23.4	246.0	5.55	50.60	129.6	1211.0
26	18.0	264.0	5.49	56.09	98.8	1309.8
28	17.2	281.3	5.85	61.94	100.7	1410.5
30	19.4	300.6	5.58	67.52	108.1	1518.7

Appendix C

Plot Data Means for Runoff, Sediment Concentration, and Soil Loss for the Study Sites

Averages

Toronto
September 29, 1990

Interval Sediment Concentration (g/L)

Sample Time (min)	Control P3	Conwed	Ecofibre	Verdyol
2	107.92	7.20	17.50	18.23
4	74.98	7.53	12.44	22.29
6	48.10	7.58	9.72	17.71
8	35.50	7.10	11.04	13.18
10	32.37	5.12	10.15	14.94
12	25.95	5.87	8.31	14.67
14	24.70	9.38	6.11	11.42
16	23.03	7.48	6.58	11.41
18	23.40	6.09	5.52	10.69
20	21.60	4.80	7.04	9.94
22	18.78	4.42	5.81	11.63
24	18.12	3.51	6.20	9.55
26	19.30	4.05	5.50	10.20
28	18.55	3.38	4.39	13.47
30	17.35	3.71	5.04	9.03

Cumulative Sediment Concentration (g/L)

Sample Time (min)	Control P3	Conwed	Ecofibre	Verdyol
2	107.92	7.20	17.50	18.23
4	182.90	14.73	29.94	40.51
6	231.00	22.31	39.66	58.22
8	266.50	29.41	50.70	71.40
10	298.87	34.53	60.85	86.34
12	324.82	40.40	69.17	101.01
14	349.52	49.78	75.28	112.43
16	372.54	57.26	81.86	123.84
18	395.94	63.35	87.38	134.53
20	417.54	68.15	94.42	144.47
22	436.32	72.57	100.23	156.10
24	454.43	76.08	106.43	165.65
26	473.73	80.13	111.93	175.85
28	492.28	83.51	116.33	189.31
30	509.63	87.22	121.37	198.34

Interval Runoff (L)

Sample Time (min)	Control P3	Conwed	Ecofibre	Verdyol
2	1.61	0.55	0.48	0.76
4	4.75	1.71	1.79	2.74
6	4.75	2.29	2.52	3.20
8	4.58	2.65	3.31	3.38
10	4.24	2.99	3.70	3.55
12	4.64	3.14	4.04	3.78
14	4.18	3.60	3.97	4.02
16	4.64	3.63	3.95	4.02
18	4.83	3.97	4.57	4.05
20	4.10	3.98	4.77	4.14
22	4.51	4.20	4.89	4.44
24	4.80	4.12	4.82	4.06
26	4.19	3.96	5.04	4.30
28	4.74	3.96	5.00	4.21
30	4.63	4.33	3.67	4.14

Cumulative Runoff(L)

Sample Time (min)	Control P3	Conwed	Ecofibre	Verdyol
2	1.61	0.55	0.48	0.76
4	6.37	2.26	2.27	3.50
6	11.12	4.55	4.79	6.70
8	15.70	7.19	8.10	10.08
10	19.94	10.18	11.80	13.63
12	24.58	13.32	15.84	17.41
14	28.75	16.92	19.81	21.43
16	33.39	20.54	23.76	25.45
18	38.22	24.51	28.33	29.50
20	42.32	28.49	33.10	33.64
22	46.83	32.68	37.98	38.08
24	51.63	36.80	42.80	42.13
26	55.82	40.76	47.84	46.44
28	60.56	44.72	52.84	50.64
30	65.19	49.05	56.51	54.79

Interval Soil Loss (g)

Sample Time (min)	Control P3	Conwed	Ecofibre	Verdyol
2	167.07	3.93	8.71	11.22
4	354.73	11.44	23.92	60.70
6	223.98	14.81	26.60	57.71
8	160.58	16.05	38.34	45.18
10	137.53	13.70	38.41	53.99
12	121.73	16.99	34.76	56.11
14	103.30	31.24	24.94	45.85
16	106.96	24.71	25.63	45.83
18	113.35	22.53	25.40	43.96
20	88.47	17.86	33.78	41.60
22	84.79	17.43	28.23	52.03
24	86.49	13.82	29.85	38.70
26	80.80	15.87	28.13	44.22
28	87.68	12.63	22.34	57.82
30	80.68	15.14	25.93	37.50

Cumulative Soil Loss (g)

Sample Time (min)	Control P3	Conwed	Ecofibre	Verdyol
2	149.35	3.93	8.71	11.22
4	405.56	15.38	32.62	71.91
6	556.24	30.18	59.23	129.63
8	656.33	46.24	97.57	174.81
10	740.94	59.94	135.98	228.79
12	814.72	76.92	170.74	284.91
14	878.09	108.16	195.68	330.76
16	945.85	132.88	221.31	376.59
18	1018.85	155.40	246.71	420.55
20	1073.13	173.27	280.49	462.15
22	1126.33	190.70	308.72	514.18
24	1187.16	204.52	338.57	552.88
26	1241.49	220.38	366.71	597.10
28	1295.29	233.01	389.05	654.92
30	1347.32	248.15	414.98	692.42

Albion Hills
November 18, 1990

Interval Sediment Concentration

Sample Time (min)	Control	Mulch (AH)
4	32.98	13.03
6	36.65	1.03
8	35.80	0.76
10	33.60	0.47
12	31.67	0.58
14	25.27	0.65
16	26.25	0.59
18	26.78	0.47
20	29.08	0.67
22	28.30	0.45
24	22.98	0.75
26	22.85	1.07
28	23.85	0.80
30	20.75	0.87

Cumulative Sediment Concentration

Sample Time (min)	Control	Mulch (AH)
4	32.98	13.03
6	69.63	14.06
8	126.53	14.82
10	160.13	15.29
12	191.80	15.87
14	217.07	16.53
16	243.32	17.12
18	270.10	17.59
20	299.18	18.25
22	327.48	18.70
24	350.47	19.45
26	373.32	20.52
28	397.17	21.32
30	417.92	22.19

Interval Runoff

Sample Time (min)	Control	Mulch (AH)
4	7.31	2.53
6	4.52	4.46
8	5.19	4.95
10	5.46	5.34
12	5.45	5.55
14	5.51	5.83
16	5.67	5.56
18	5.66	5.81
20	5.84	6.07
22	5.81	5.84
24	5.72	6.05
26	5.51	5.81
28	5.69	6.07
30	5.51	5.99

Cumulative Runoff

Sample Time (min)	Control	Mulch (AH)
4	7.31	2.53
6	11.84	6.98
8	17.03	11.93
10	22.48	17.27
12	27.93	22.82
14	33.45	28.64
16	39.12	34.21
18	44.78	40.02
20	50.62	46.09
22	56.42	51.94
24	62.14	57.99
26	67.65	63.80
28	73.34	69.82
30	78.86	75.81

Interval Soil Loss

Sample Time (min)	Control	Mulch (AH)
4	246.19	16.64
6	172.61	4.31
8	308.14	4.04
10	185.53	2.54
12	173.99	3.28
14	138.83	3.91
16	149.93	3.37
18	153.50	2.75
20	172.63	4.07
22	165.04	2.64
24	131.65	4.59
26	126.02	6.26
28	136.40	4.97
30	113.90	5.24

Cumulative Soil Loss

Sample Time (min)	Control	Mulch (AH)
4	246.19	16.64
6	418.80	20.95
8	726.94	25.00
10	912.46	27.53
12	1086.46	30.82
14	1225.29	34.73
16	1375.22	38.10
18	1528.72	40.84
20	1701.35	44.92
22	1866.39	47.56
24	1998.05	52.15
26	2124.07	58.42
28	2260.47	63.38
30	2374.37	68.62

Waterloo
November 2, 1990

Interval Sediment Concentration

Sample Time (min)	Control	Curlex	Aeromat	S75
4	138.65	3.65	1.12	2.73
6	177.15	3.62	1.08	9.26
8	189.38	4.27	1.59	11.75
10	163.06	8.39	1.64	14.67
12	116.07	11.46	1.87	14.75
14	101.47	7.66	1.45	11.23
16	112.37	13.07	1.55	12.71
18	77.48	18.07	1.29	19.32
20	88.95	8.14	1.51	17.23
22	79.78	12.96	1.63	13.75
24	64.65	9.29	1.62	14.86
26	55.82	7.45	1.43	12.65
28	57.05	9.79	1.25	10.59
30	58.27	8.33	1.31	11.89

Cumulative Sediment Concentration

Sample Time (min)	Control	Curlex	Aeromat	S75
4	138.65	3.65	1.12	2.73
6	315.80	7.27	2.20	11.99
8	505.18	11.53	3.79	23.73
10	668.24	19.93	5.43	38.40
12	784.30	31.39	7.30	53.15
14	885.77	39.05	8.75	64.38
16	989.14	52.11	10.30	77.09
18	1075.62	70.18	11.59	96.41
20	1164.57	78.32	13.10	113.64
22	1244.35	91.28	14.73	127.39
24	1309.00	100.57	16.35	142.25
26	1364.82	108.01	17.78	154.90
28	1421.87	117.81	19.03	165.49
30	1480.14	126.13	20.33	177.38

Interval Runoff

Sample Time (min)	Control	Curlex	Aeromat	S75
4	3.59	0.24	2.42	0.81
6	4.84	1.21	3.63	2.17
8	5.39	1.80	4.65	3.42
10	5.60	2.97	5.36	4.03
12	5.25	3.35	5.43	4.57
14	5.42	3.95	5.49	4.72
16	6.11	4.04	5.60	4.91
18	5.59	4.17	5.64	5.16
20	5.38	4.37	5.79	5.34
22	5.31	4.49	5.75	5.16
24	5.23	4.57	5.82	5.41
26	5.37	4.68	5.88	5.35
28	5.63	4.92	6.14	5.42
30	5.41	4.87	5.71	5.40

Cumulative Runoff

Sample Time (min)	Control	Curlex	Aeromat	S75
4	3.59	0.24	2.42	0.81
6	8.42	1.45	6.05	2.98
8	13.81	3.25	10.70	6.39
10	19.41	6.22	16.06	10.43
12	24.67	9.57	21.49	14.99
14	30.09	13.52	26.98	19.72
16	36.19	17.56	32.58	24.63
18	41.78	21.73	38.22	29.79
20	47.16	26.11	44.02	35.13
22	52.47	30.59	49.76	40.29
24	57.70	35.17	55.58	45.70
26	63.07	39.84	61.46	51.05
28	68.69	44.76	67.60	56.47
30	74.10	49.63	73.32	61.87

Interval Soil Loss

Sample Time (min)	Control	Curlex	Aeromat	S75
4	723.01	2.26	2.81	2.69
6	879.94	5.12	4.06	24.83
8	1015.52	10.22	7.36	47.37
10	912.77	29.64	8.94	65.69
12	608.62	40.32	10.24	71.06
14	546.30	28.27	7.89	54.01
16	684.44	55.54	8.80	63.04
18	430.62	78.34	7.35	100.00
20	475.03	35.42	8.89	92.74
22	423.87	57.36	9.47	71.74
24	334.26	42.78	9.65	81.26
26	297.94	34.31	8.49	67.25
28	316.13	47.63	7.86	58.98
30	314.92	40.67	7.52	63.31

Cumulative Soil Loss

Sample Time (min)	Control	Curlex	Aeromat	S75
4	723.01	2.26	2.81	2.70
6	1602.96	7.38	6.87	27.53
8	2618.47	17.60	14.22	74.90
10	3531.25	47.24	23.16	140.59
12	4139.87	87.56	33.40	211.65
14	4686.16	115.82	41.29	265.66
16	5370.60	171.37	50.09	328.70
18	5801.22	249.70	57.44	428.71
20	6276.25	285.12	66.33	521.44
22	6700.13	342.48	75.81	593.18
24	7034.38	385.26	85.46	674.44
26	7332.32	419.57	93.94	741.69
28	7648.46	467.20	101.81	800.66
30	7963.38	507.86	109.32	863.97